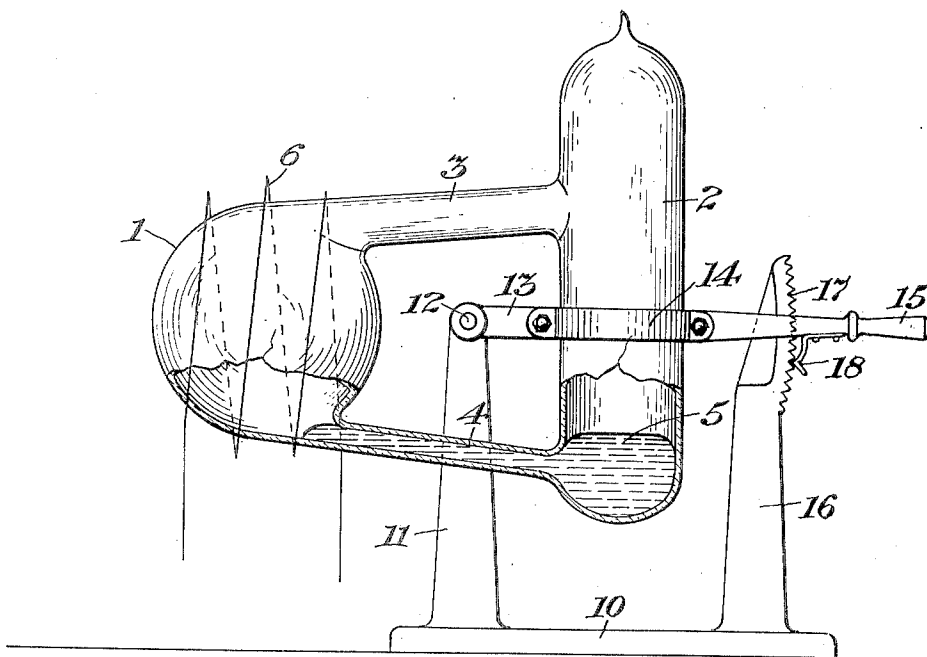


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T. E. FOULKE
ELECTRIC DISCHARGE DEVICE

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ELECTRIC DISCHARGE DEVICE

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The present invention relates to electric discharge devices, and particularly to electrodeless discharge devices in which a condensable vapor is used.

3 The particular object of the invention is to provide a discharge device of this type which will continuously emit radiations of great intensity. Another object is to provide means for controlling the vapor pressure of such a device. Further objects and advantages of the invention will appear from the following particular description of one embodiment of my invention, or from an inspection of the accompanying drawing.

10 Electrodeless discharge devices of the type in which a high frequency magnetic field induces a discharge in a condensable vapor such as mercury as heretofore produced have been greatly limited in their use due to the fact that an intense discharge yielding a light intensity of an order greater than 50 candles per square centimeter could not be maintained therein for long periods of time. The high energy input into such a device 25 necessary to produce the intense discharge increases the temperature of the device, which in turn causes a great increase in the vapor pressure therein. As is well known, as the vapor pressure of mercury increases a more or less critical pressure is reached, after which a slight increase in pressure causes an abrupt decrease in the intensity of a discharge therein until only the extremely weak emerald green glow characteristic of the so-called high pressure discharge is emitted. 35 In practice it has been found that this critical pressure is attained even before the quartz envelope of such a device has attained a red heat. As a result it has been necessary to limit the energy input to these devices so as to maintain the vapor pressure below this critical value. By the present invention a means for controlling this vapor pressure has been provided, whereby previous limitations on energy input can be greatly exceeded, as a result of which it has been found possible to run such a device at a temperature corresponding to a red heat of quartz for long periods of time, permitting almost 50 a four-fold increase in the amount of light

emitted thereby. This has been accomplished by the use of a condensing chamber connected to the discharge device into which the hot vapor passes to be condensed. The condensate is then returned to the discharge device in measured quantities to keep said device supplied with a constant source of vapor. In this manner the vapor pressure within the discharge device is maintained below the critical value, in spite of the fact that energy 60 is being impressed on the device in amounts sufficient to produce the high pressure discharge if the device were being operated without the condensing unit.

The accompanying drawing is an elevational view, partly in section of a device embodying my invention.

In the drawing a spherical discharge chamber 1 communicates with the condensing chamber 2 through the passages 3 and 4. The passage 3 opens into the chamber 1 tangentially at the uppermost point of said chamber, and continuously ascends from said chamber 1 to the point where it opens into the side of the condensing chamber 2, preferably some distance from the top of said chamber 2. The passage 4 opens into the chamber 1 tangentially at the lowest point in said chamber, and in the preferred form continuously descends to the point where it opens into the condensing chamber 2, near the bottom thereof. This entire structure is made of fused silica, in order to withstand the temperatures which result from the high energy input under which the device is operated. Mercury 5 is provided in the condensing chamber 2 to a level just sufficient to cause the column thereof in the passage 4 to extend a short distance into the discharge chamber 1. The passage 4 should be of sufficient diameter to permit the ready flow of mercury. The condensing chamber should be at some distance from the discharge chamber, in order to minimize the radiant heat which is intercepted, and the chamber 2 and passage 3 are so proportioned 95 as to produce the necessary condensation. A chamber one inch in diameter and three and one-half inches long, separated from the discharge chamber by one and one-fourth inches has proved satisfactory for a discharge cham- 100

ber one and three-fourths inches in diameter. These dimensions are, however, given only for purposes of illustration. A coil 6, which is connected across a suitable high frequency electromotive force, is placed about the discharge chamber 1 for the energization thereof. For self starting purposes the device preferably contains a small quantity of one of the rare gases or any other inert gas, or a mixture thereof, as set forth in my pending application Serial No. 101,001 filed April 9, 1926.

In the manufacture of a device according to this invention the usual precautions must be taken to insure that the entire system is free of water vapor and occluded gases, the preferred method being to give the envelope a rough exhaust after which the desired amount of distilled mercury is placed therein. The device is then given its final exhaust, during which the temperature of the device is raised by means of applying a torch or baking in an oven. An induction discharge considerably above normal is set up in the device while still on the pump, whereby certain impurities which tend to shorten the life of the device are removed. When the device has cooled the rare gas, if used, is admitted, and the device sealed off. The device is then ready for operation.

This device is then preferably mounted in such manner that it can be tilted. As shown a base 10 carries a vertical support member 11, at the upper end of which is the pivot 12 which supports the lever 13, thereby supporting the entire discharge device. A handle 15 is provided for the operation of the lever 13. The base 10 also carries an upright 16, which has near its top the serrations 17 arranged along a segment of a circle struck from the pivot 12. A spring dog 18 carried by the lever 13 engages these serrations and provides means for yieldably holding the lever 13 in any desired position.

During the operation of the device a discharge is produced in the mercury vapor in the chamber 1 under the influence of the field produced by the coil 6. The hot mercury vapor tends to rise and thus passes through the passage 3 to the condensing chamber 2, which is relatively cool since it is some distance from the discharge. The vapor here condenses, the condensate collecting in the pool 5. An equivalent amount of mercury has in the meantime passed through the passage 4 to the discharge chamber 1 to serve as a replacement for the evaporated mercury. In this way the level of the pool 5 is maintained and a constant supply of mercury is provided for the discharge chamber 1, regardless of the rate of evaporation. The vapor pressure thus maintained within the device during operation may be varied by tilting the device by means of the handle 15 whereby the amount of mercury protruding

into the chamber 1 from the passage 4 is varied. The more mercury there is thus exposed to the discharge the higher the rate of evaporation becomes. The vapor pressure therefore increases until the rate of condensation, due to the higher operating temperature, increases to the point where it again equals the rate of evaporation. In like manner tilting the device in the opposite direction will decrease the vapor pressure. As a result of this means of control this device can be adapted to various rates of electrical input, atmospheric conditions and the like without structural change, a feature which is of the greatest importance.

Customary means for increasing or decreasing the rate of cooling of the chamber 2 could advantageously be employed to regulate the vapor pressure within the device. For example, an asbestos sheath might be placed about the chamber 2 to decrease the rate of cooling, and thereby increase the vapor pressure, while a metallic sheath with or without cooling fins might be employed to increase the rate of cooling and thereby decrease the vapor pressure within the device.

While I have shown and described and have pointed out in the annexed claims certain novel features of the invention, it will be understood that various omissions, substitutions in the forms, parts and details of the device illustrated may be made by those skilled in the art without departing from the spirit of the invention.

I claim:

1. An electromagnetic induction discharge device comprising a discharge chamber, a condensing chamber, a passage from the lower part of said condensing chamber to the lower part of said discharge chamber, mercury in said condensing chamber and said passage, said mercury extending from said passage a short distance into said discharge chamber, and a passage for mercury vapor from the upper part of said discharge chamber to the upper part of said condensing chamber.

2. In combination, a gaseous discharge device comprising a discharge chamber, a condensing chamber, a passage from the lower part of said discharge chamber to the lower part of said condensing chamber, a second passage from the upper part of said discharge chamber to the upper part of said condensing chamber, mercury in said device, and means for varying the relative rate of evaporation and condensation of said mercury.

3. In combination, a gaseous discharge device comprising a discharge chamber, a condensing chamber, a passage from the lower part of said discharge chamber to the lower part of said condensing chamber, a second passage from the upper part of said discharge chamber to the upper part of said condensing chamber, mercury in said con-

densing chamber and extending through said lower passage into said discharge chamber, and means for varying the amount of mercury extending into said discharge chamber.

5 4. The method of controlling the vapor pressure of a gaseous discharge device having a discharge chamber, a condensing surface, and a condensable vapor in said chamber, which consists in varying the quantity of
10 condensed vapor exposed to the discharge in said discharge chamber to vary the rate of evaporation thereof.

5 5. The method of operating an electric vapor discharge device which comprises producing an electromagnetic induction discharge in said vapor in a suitable discharge
15 chamber, continuously condensing some of said vapor in a chamber remote from said discharge chamber, collecting said condensed vapor, and returning it to said discharge chamber through an opening in the
20 bottom thereof.

6. The method of operating an electric vapor discharge device which comprises producing a discharge in said vapor in a suitable discharge chamber, continuously condensing some of said vapor in a chamber remote from said discharge chamber, collecting
25 said condensed vapor, returning it to said discharge chamber through an opening in the bottom thereof, and varying the amount of said condensed vapor exposed to the discharge to vary the rate of evaporation thereof.

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35 Signed at Hoboken in the county of Hudson and State of New Jersey this first day of December, A. D. 1928.

TED EUGENE FOULKE.

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