

April 12, 1960

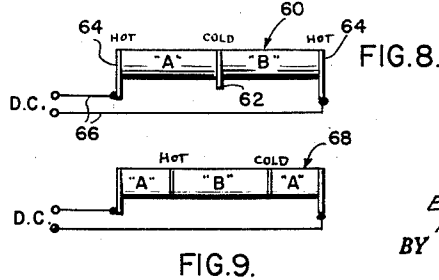
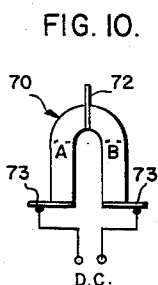
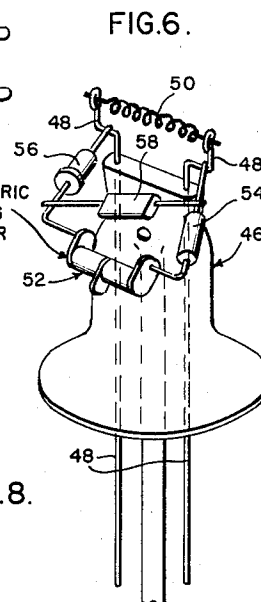
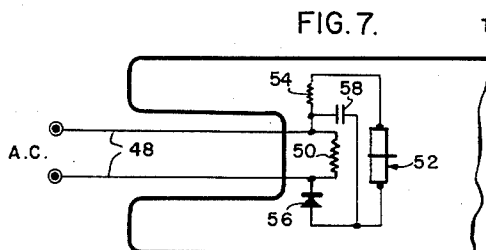
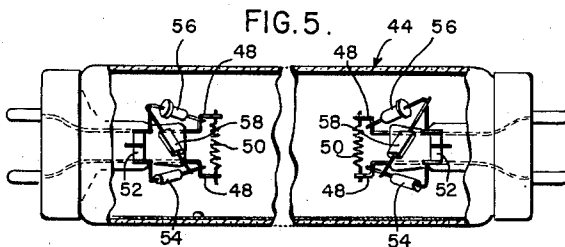
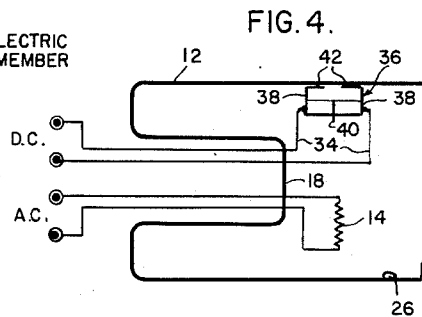
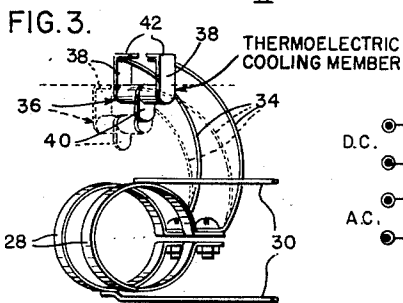
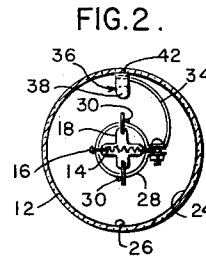
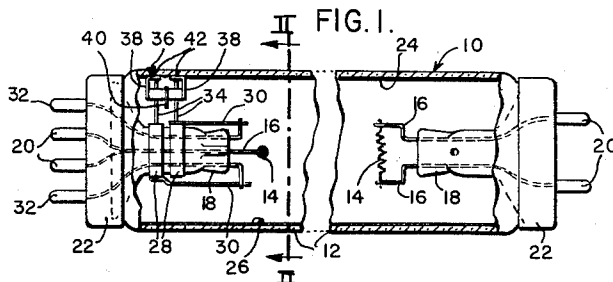
E. G. F. ARNOTT ET AL

2,932,753

DISCHARGE DEVICE

Filed Oct. 29, 1958

2 Sheets-Sheet 1



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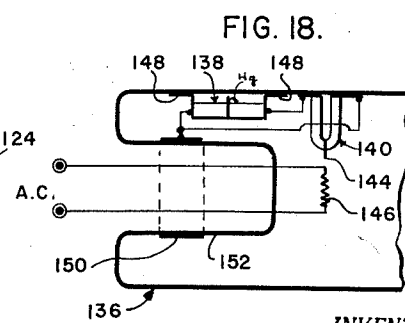
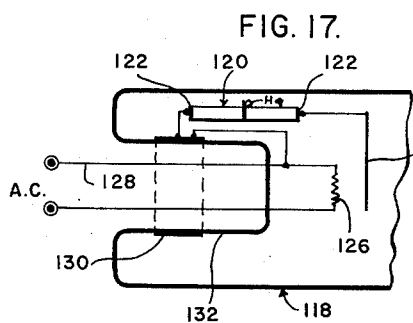
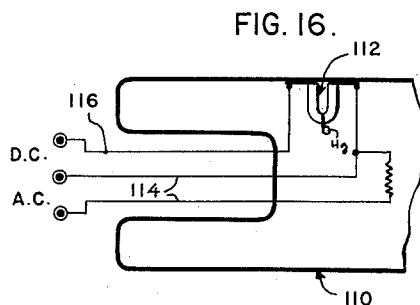
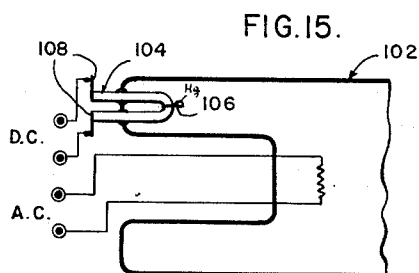
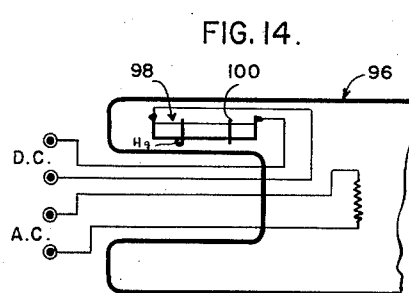
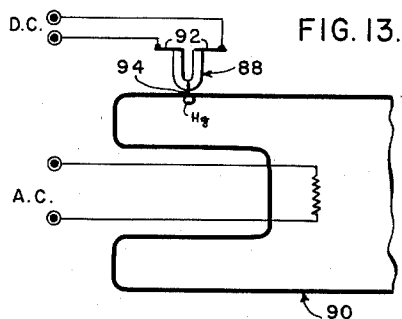
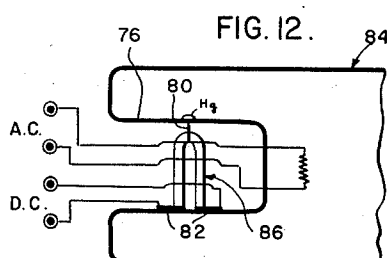
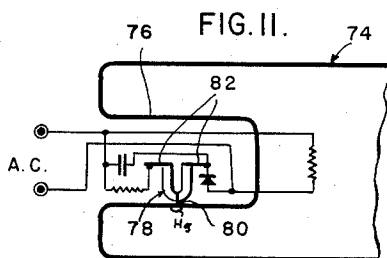
E. G. F. ARNOTT ET AL

2,932,753

DISCHARGE DEVICE

Filed Oct. 29, 1958

2 Sheets-Sheet 2



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2,932,753

DISCHARGE DEVICE

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Application October 29, 1958, Serial No. 770,410

20 Claims. (Cl. 313-42)

This invention relates to radiation-generating discharge devices and, more particularly, to low-pressure, mercury-vapor discharge devices intended to be operated under conditions of relatively high loading or temperature.

It is well known that the standard fluorescent lamp operates with the greatest lumen per watt efficiency when the mercury-vapor pressure within the lamp is from about 6 to 9 microns. A mercury-vapor pressure within this range is readily obtained by having a region within the lamp where condensed mercury is at a temperature of from about 40° C. to 45° C. With the standard fluorescent lamp, this condition is readily obtained without difficulty. Where fluorescent lamps are operated with greater power input without auxiliary arrangements for controlling the mercury-vapor pressure, the higher power input per volume of the lamp will result in increased mercury-vapor pressure, thereby decreasing the efficiency of the lamp. As an example, the usual fluorescent lamp operates with a loading of about 10 watts per foot of lamp length. Higher-loaded lamps can operate with a loading of about 25 watts per foot of length and the degree of increased loading can be varied considerably. In order to decrease the operating mercury-vapor pressure within the so-called higher-loaded lamps, and thereby at least approach a maximum of efficiency in generating ultraviolet radiations, it has been necessary to cool a portion of the envelope to a temperature of about 40° C.-45° C., since the coolest portion of the envelope determines the equilibrium pressure of the mercury vapor contained within the envelope. With auxiliary cooling means, fluorescent lamps can be operated with a much-higher power input and still maintain good efficiency in generating ultraviolet radiations.

Similar problems have also existed in ultraviolet-radiation generators such as are used in bactericidal applications. As an example, ultraviolet-radiation generators designed for killing micro-organisms have been placed in the ducts of forced hot-air heaters. The temperatures encountered within some of these ducts, however, have been such that the efficiency of the device in generating the organism-killing radiations has been impaired. Thus whenever the mercury-vapor pressure within the discharge device exceeds that pressure desired for optimum efficiency, the output of the device suffers, irrespective of whether the device is operated with increased power input or is operated under relatively-high ambient-temperature conditions, or both.

In order to cool at least a portion of the envelope in so-called high-loaded discharge devices, it has been proposed to deform the envelopes of such devices to provide for discrete cooler envelope portions. Such a procedure is costly and decreases the strength of the envelope. In addition, deformed envelopes are not effective to control the mercury-vapor pressure under conditions of high-ambient temperature. It has also been proposed to use a heat-shielding means at least at one end of the envelope to form a cooling chamber, which chamber controls the mercury-vapor pressure within the discharge

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device. The heat shield while functioning in the desired fashion also screens the ultraviolet radiations from the end of the lamp so that in the case of a fluorescent lamp, the end or ends of the device are necessarily dark. Further, this construction will not work under relatively high ambient temperatures, such as may be encountered in an air duct or in an enclosed fixture, for example.

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior-art practices by the provision of a discharge device which operates with good efficiency under conditions of high loading or high ambient temperatures or both, without the necessity of special envelope configurations or heat shields and without the disadvantages associated with such constructions.

It is another object to provide various constructional details for mercury-vapor discharge devices desired to be operated at high efficiency under such conditions as would normally cause the operating mercury-vapor pressure within such devices to exceed the pressure desired.

It is a further object to provide various cooling arrangements and constructions and electrical connections therefor for controlling the mercury-vapor pressure within a mercury-vapor discharge device so that the device operates with high efficiency.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing radiation-generating devices, preferably of the low-pressure, mercury-vapor fluorescent type, having associated therewith a cooling means comprising a thermoelectric cooling member, acting when properly energized to cool a selected location within the radiation-generating devices. This cooled location within the devices serves to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired for maximum operating efficiency.

For a better understanding of the invention, reference should be had to the accompanying drawings wherein:

Fig. 1 is an elevational view, partly broken away, showing a low-pressure, mercury-vapor discharge device of the fluorescent type having at one end thereof a thermoelectric cooling member;

Fig. 2 is a sectional view taken on the line II-II in Fig. 1 in the direction of the arrows;

Fig. 3 is a perspective view of the mounting arrangement and electrical connections for the thermoelectric cooling member as shown in Fig. 1;

Fig. 4 is a diagrammatic representation of the thermoelectric cooling member and device electrode and electrical connections thereto for the device embodiment as shown in Fig. 1;

Fig. 5 is an elevational view, partly broken away, showing a discharge device incorporating an alternative cooling member construction;

Fig. 6 is a perspective view of the mount, thermoelectric cooling element and electrode construction for the device embodiment as shown in Fig. 5;

Fig. 7 is a diagrammatic representation of the thermoelectric cooling member and electrode arrangement for the device embodiment as shown in Fig. 5;

Fig. 8 illustrates one construction for a thermoelectric cooling member;

Fig. 9 illustrates another construction for a thermoelectric cooling member;

Fig. 10 illustrates still another construction for a thermoelectric cooling member;

Fig. 11 is a diagrammatic representation of an alternative discharge device and thermoelectric cooling member arrangement wherein the thermoelectric member is positioned within the flare at one end of the device envelope;

Fig. 12 is a diagrammatic representation of another

device embodiment wherein a separately-energizable thermoelectric cooling member is positioned within one of the flares of the discharge device;

Fig. 13 is a diagrammatic representation of a device embodiment wherein the thermoelectric cooling member is positioned completely exterior to the discharge device;

Fig. 14 is a diagrammatic representation of a device embodiment generally corresponding to that embodiment shown in Fig. 1, but wherein the thermoelectric cooling member is modified;

Fig. 15 is a diagrammatic representation illustrating yet another device embodiment wherein the thermoelectric member hot junction is positioned exterior to the envelope and the thermoelectric member cold junction is positioned within the envelope;

Fig. 16 is a diagrammatic representation of an additional alternative device embodiment wherein one of the lead conductors for an electrode of the device is also used to supply energizing potential to the thermoelectric cooling member;

Fig. 17 is a diagrammatic representation of an embodiment wherein the thermoelectric member has energizing potential supplied thereto by means of a probe extending into the discharge path of the device;

Fig. 18 is a diagrammatic representation of an embodiment wherein a potential generator actuated by heat from an electrode of the device supplies energizing potential to the thermoelectric cooling member.

Although the principles of the invention are broadly applicable to any metallic-vapor discharge device desired to be operated under such conditions as would normally cause the operating metallic-vapor pressure within the device to exceed that pressure desired, the invention is usually employed in conjunction with a low-pressure, mercury-vapor discharge device of the fluorescent type and hence it has been so illustrated and will be so described.

The cooling element or member, which is utilized in the present invention to cool a selected location within the radiation-generating device to control the mercury-vapor pressure, operates with what is known as the Peltier effect. The Peltier effect can be defined as the reversible transformation of electrical potential energy and heat at a junction of dissimilar conductors. This effect was discovered over one hundred years ago. Such thermoelectric cooling members operate on the principle that if D.C. current is made to flow in the proper direction across a junction of two dissimilar materials, heat is converted to electrical potential energy and the junction is cooled. Current in the reverse direction heats the junction. The amount of heat transformed or converted at the junction is proportional to the current density and to the so-called Peltier coefficient of the junction. The latter depends upon the materials comprising the junction and the temperature of the junction. The basic thermoelectric cooling element has two junctions, a cold junction and a hot junction. The hot junction may be attached to a "heat sink" in order to dissipate the generated heat, since the temperature of the cold junction is determined in part by the temperature differential between the cold and hot junctions. Many different combinations of dissimilar materials will display this so-called Peltier effect and the difference in temperature between the hot and cold junctions has been reported to be as much as 40° C. using a p-type Bi_2Te_3 and Bi, 60° C. using p-type Bi_2Te_3 and n-type Bi_2Te_3 , and 80° C. using other materials. A comprehensive article on such junctions can be found in "Journal of Applied Physics," vol. 28, No. 9, pages 1035-1042 (September 1957), article by Shilliday. Another comprehensive article on thermoelectric cooling members can be found in Jaumot article, "Proceedings of the I.R.E.," volume 46, No. 3, pages 538-554 (March 1958). Other materials which display good Peltier cooling effects are disclosed in U.S. Patent No. 2,758,146, dated August 7, 1956, and many other such materials are known.

With specific reference to the form of the invention illustrated in the drawings, in Figs. 1 and 2 are disclosed a radiation-generating device 10, which in the preferred form is a low-pressure, mercury-vapor discharge device usually known as a fluorescent lamp. As is customary, the device 10 comprises an elongated envelope 12 having electrodes 14 operatively disposed at each end thereof. Electrode lead conductors 16 are sealed through the ends of the envelope 12 through a stem press 18. The lead conductors 16 electrically connect to base pins 20 which are fixed to base caps 22 in order to facilitate energizing the device 10. The envelope 12 carries on its interior surface a coating of phosphor material 24, such as zinc silicate activated by manganese. A small charge of mercury 26 and an inert ionizable gas such as argon at a pressure of 3 millimeters for example are also contained within the envelope 12. Metallic clamps 28, shown in perspective view in Fig. 3, are secured about the stem press 18 and are electrically insulated from one another. Additional lead conductors 30, sealed through stem press 18, electrically connect to each of the metallic clamps 28 and in turn are connected to additional base pins 32 which are adapted to have a D.C.-energizing potential applied thereacross. Metallic spring wires 34 electrically connect to and are supported by the metallic clamps 28 and a thermoelectric cooling member 36 is electrically connected to and supported by the spring wires 34. The thermoelectric cooling member 36 will be so described in greater detail hereinafter, but briefly comprises two hot junctions 38 positioned at either end of the member 36 and a cold junction 40 positioned proximate the midpoint of the cooling member 36. The cold junction 40 is slightly enlarged in order that the mercury-vapor pressure within the device 10 can be readily controlled during operation. The spring wires 34 maintain the extending legs 42 of the cooling member 36 in contact with the envelope 12 in order that heat produced is readily dissipated (spring action shown in dotted lines in Fig. 3). Thus in this embodiment, the envelope 12 acts as a heat sink to dissipate heat generated by the hot junctions 38. Constructional details for the thermoelectric cooling member 36 will be considered hereinafter. A diagrammatic representation for the embodiment as illustrated in Figs. 1-3 is shown in Fig. 4.

In Fig. 5 is shown a highly-loaded discharge device 44 which is designed to be operated with energizing potential applied across both of the base pins, such as in a so-called rapid-start fluorescent lamp designed to be operated at 1,500 cycles and having a four foot T12-type envelope and a power input of 100 watts. Such a lamp has a separate voltage applied across each of its electrodes during operation. In other respects, this device embodiment 44 differs from the device 10 shown in Fig. 1 in the mount construction, which is shown in perspective view in Fig. 6. The mount 46 has lead conductors 48 sealed therethrough and electrically connected to an electrode 50. A thermoelectric cooling member 52, which will be described in greater detail hereinafter, is electrically connected across the lead conductors 48 parallel to the electrode 50. In order to provide rectified current of the proper magnitude, a dropping resistor 54 and a rectifier 56 electrically connect in series with the cooling member 52. A condenser 58 for filtering the rectified energizing potential is connected in parallel across the cooling member 52 and resistor 54. The rectifier 56 can comprise a commercially-available silicon rectifier for example. The dropping resistor 54 can have a resistance of 0.24 ohm and the filter capacitor 58 can have a capacity of 5,000 microfarads. The schematic representation for this arrangement is shown in Fig. 7. In the embodiment as shown in Figs. 5-7, cooling members 52 are provided at both ends of the device 44 and in any of the embodiments as disclosed herein, cooling members can be provided either at one end or at both

ends of the discharge devices. A cooling member at one end of a discharge device has the advantage of simplicity of construction and the operation is generally satisfactory, although in order to minimize any possible mercury pumping, it is desirable in some cases to provide cooling members at both ends of the discharge devices as illustrated and described.

Fig. 8 illustrates a thermoelectric cooling member 60 which can be used in the discharge devices shown in Figs. 1 and 5. This cooling member is formed of two dissimilar conductors. The conductor designated "A" can be formed of n-type bismuth telluride and the conductor designated "B" can be formed of p-type bismuth telluride. The cold junction is formed at the junction of the two metals by soldering a thin strip of copper 62 therebetween. If desired, the conductors "A" and "B" can be soldered directly to one another to form the cold junction. The hot junctions are located at the separated extremities of the conductors "A" and "B" and are formed by soldering copper discs 64 to the ends of these conductive materials. The lead conductors 66 are soldered directly to the enlarged copper discs 64 which form the hot junctions. As a specific example, each of the materials "A" and "B" have a diameter of 0.54 centimeter and a length of 1.3 centimeters. Under actual operating conditions, with an operating potential of 0.07 volt and a current of 5 amperes, a 16° C. temperature drop has been achieved at the cold junction. With the thermoelectric cooling member construction as shown in Fig. 8, up to 25° C. cooling can be obtained by varying the energizing potential. The degree of cooling required for any specific lamp will depend upon the conditions under which the lamp is to be operated, the power rating for the lamp and other constructional details such as the wattage loading per unit volume of envelope. The foregoing specific thermoelectric cooling member 60 is suitable for operation with a four foot fluorescent lamp having an envelope diameter of one and one-half inches and designed to be operated in an open fixture with a power input of twenty-five watts per foot. With enclosed fixtures or where high ambient temperatures are encountered, however, the degree of cooling required for optimum operating mercury-vapor pressure will normally be increased and the power input to the cooling member and its design can be altered accordingly. In the cooling member embodiment 60 as shown in Fig. 8, the hot junctions are provided with an enlarged area and this is accomplished by providing the copper discs 64 with a diameter of 1.5 centimeters. If these copper discs 64 are not directly connected to a heat sink in order to dissipate the generated heat, they can be provided with a darkened surface in order to increase their radiating capacity.

In Fig. 9 is shown another construction for a thermoelectric cooling member 68 wherein the conductors designated "A" and "B" are as in the embodiment 60 shown in Fig. 8 except that each conducting member "A" has a length of 0.65 centimeter. In the embodiment 68 as shown in Fig. 9, however, neither the cold nor the hot junctions are provided with an enlarged area. The operating conditions and the degree of cooling for this embodiment 68 can be as previously given for the embodiment 60 shown in Fig. 8.

In Fig. 10 is illustrated still another construction for a thermoelectric cooling member 70 wherein the conducting members "A" and "B" are preformed and electrically connect to form an enlarged cold junction 72 in order to enable the cooling member 70 to operate more effectively. This embodiment can correspond to the cooling member embodiments as previously illustrated and described except that both the hot junctions 73 and cold junction 72 are provided with enlarged areas as is readily accomplished by forming these junctions as soldered copper discs having a diameter of 1.5 centimeters. In any of the foregoing thermoelectric cooling member em-

bodiments 60, 68 and 70, either or both the cold and hot junctions can be provided with an enlarged area if desired.

The device embodiments 10 and 44 as shown in Figs. 1 or 5 can readily be altered to produce a bactericidal lamp by eliminating the phosphor coating on the inner surface of the envelopes and fabricating the envelopes of material which transmits ultraviolet radiations of the required wavelengths.

With the exception of the thermoelectric cooling members which are utilized, the device embodiments 10 and 44 as shown in Figs. 1 and 5 are of generally-conventional construction. Many other discharge-device embodiments incorporating thermoelectric cooling members are also possible and will be considered hereinafter. In order to facilitate the description thereof, these further embodiments are shown only in diagrammatic form since, with the exception of the thermoelectric cooling members, these discharge devices are generally conventional, as in the previously-described device embodiments.

In Fig. 11 is shown a diagrammatic representation of a rapid-start type of lamp 74, generally similar to the lamp 44 shown in Fig. 5, but wherein the thermoelectric cooling member is positioned within a vitreous flare 76. The thermoelectric cooling member 78 can be generally-similar to the member 70 shown in Fig. 10, with the associated rectifier, capacitor and dropping resistor elements the same as used in conjunction with the device embodiment 44 shown in Figs. 5 and 6. The cold junction 80 of cooling member 78 is in contacting relationship with a preselected portion of the surface of the flare 76. Mercury will condense on the flare 76 inside the envelope proximate this cooled flare surface to control the operating mercury-vapor pressure within the device 74. The thermoelectric cooling member 78 as shown in Fig. 11 has hot junctions 82 which are not in contacting relationship with any "heat sink" member. In such a case, the enlarged surfaces of the hot junctions 82 are desirably provided with excellent thermal radiating properties, such as realized with conventional carbonized surfaces. For most efficient operation of the cooling member 78, the hot junctions 82 are also in contacting relationship with a portion of the vitreous flare 76 which is spaced from the cold junction flare-contacting portion. Thus the vitreous flare member 76 serves the dual function of conducting heat from the hot junctions 82 and also transferring heat to the cold junction 80 in order to condense mercury thereat. Such a discharge device embodiment 84 is shown in Fig. 12 and this embodiment also differs from the embodiment as shown in Fig. 11 in that the thermoelectric cooling member 86 is adapted to be energized separately, as in the device embodiment 10 shown in Fig. 1.

In Fig. 13 is shown another device embodiment wherein the thermoelectric member 88 is positioned completely exterior to the device 90. The thermoelectric member 88 is generally similar to the member 70 as illustrated in Fig. 10 and the discharge device 90 in other respects is of conventional design. In such an embodiment, the hot junctions 92 are readily adapted to contact thermally the metallic frame of the housing used to mount the discharge device 90 and the cold junction 94 is in contacting relationship with a preselected portion of the outer surface of the vitreous envelope of the discharge device 90. Other heat sinks can readily be provided. Mercury will condense on the inner surface of the device envelope proximate the envelope-contacting cold junction 94. Such an embodiment is readily adaptable for lamps intended to be operated in enclosed fixtures, where relatively high ambient temperatures are sometimes experienced. The temperature of the condensed mercury can actually be lower than the ambient temperature within the hot fixture surrounding the discharge device 90.

In Fig. 14 is illustrated in diagrammatic form yet an-

other device embodiment 96 which generally corresponds to the device embodiment 10 as shown in Fig. 1 except that the thermoelectric cooling member 98 generally corresponds to the cooling member 68 illustrated in Fig. 9. The cooling member 98 is somewhat modified, however, in that the hot junction 100 is not in contacting relationship with any heat sink but is provided with an enlarged radiating surface, such as in the embodiment 60 shown in Fig. 8, in order to dissipate the generated heat.

In Fig. 15 is shown in diagrammatic form a further discharge-device embodiment 102 wherein the thermoelectric cooling member 104 is generally similar to the member 70 as shown in Fig. 10. The cooling member 104 is adapted to be separately energized as in the device embodiment 10 shown in Fig. 1, but the member cold junction 106 is positioned within the envelope of the device 102 so that mercury can condense directly thereon and the hot junctions 108 are positioned exterior to the envelope of the device 102. The conducting members which comprise the thermoelectric cooling element 104 can be sealed through the vitreous envelope of the device 102 with a suitable graded vitreous seal or sealing can be made directly through the envelope by means of a suitable resin such as an epoxy resin, taking care to shield the resin from the deleterious effects of the ultraviolet radiations.

In Fig. 16 is shown yet another discharge device embodiment 110 wherein support and electrical connection for the thermoelectric cooling member 112 is provided by one of the electrode lead conductors 114 and by one additional lead conductor 116. The member 112 can otherwise generally correspond to the cooling member 70 shown in Fig. 10. In energizing the member 112, a separate D.C. potential can be applied across the additional lead conductor 116 and the electrode lead conductor 114.

In Fig. 17 is shown in diagrammatic representation still another device embodiment 118 wherein the cooling element 120 generally corresponds to the cooling element 60 as shown in Fig. 8 except that the hot junctions 122 are not enlarged. In this device embodiment 118, energizing potential for the cooling element 120 is supplied by means of a probe 124 which extends into the discharge path of the device 118 proximate the electrode 126. The electric circuit for energizing the cooling member 120 is completed by electrically connecting the other side of this cooling member 120 to the lead conductor 128 which electrically connects to the electrode 126. Support for the element 120 is readily effected by a metallic clamp 130 which fits about the stem 132 of the device 118, similar to the construction as shown in Figs. 1-3. Desirably additional electrical filter elements as previously described are included with the cooling element 120 in order to filter ripple in the D.C. potential which is picked up by the probe 124. The probe 124 can also be provided with an enlarged surface area if it is desired to increase the D.C. potential which is picked up from the discharge.

In Fig. 18 is shown in diagrammatic representation still another device embodiment 136 wherein the energizing potential for the thermoelectric cooling member 138 is provided by a potential generator 140. The potential generator is constructed similar to a standard thermocouple and is formed of two dissimilar metals, which can be similar in composition and configuration to the metals used in forming the cooling member 70 as shown in Fig. 10. In some cases, it may be desired to place two or more of such elements in series in order to generate sufficient potential to operate the cooling member 138. The junction 144 of these dissimilar metals is positioned proximate one of the electrodes 146 of the device 136 so that this junction 144 is heated by the electrode 146. This causes a D.C. current to flow from the junction 144 through the cooling member 138.

The cooling member 138 can be generally similar to the member 120 as shown in Fig. 17 except that the hot junctions 148 are desirably enlarged as in the embodiment shown in Figs. 1-4 and are in contacting relationship with the envelope of the device 136. Support for the cooling member-potential generator combination is readily effected by means of a metallic collar 150 which fits about the stem 152 of the device 136 in a manner similar to that shown in Figs. 1-3.

As is evident from the foregoing, many different device embodiments are possible with respect to varying the cooling member construction and energizing in varying fashion the thermoelectric cooling members. Where the thermoelectric cooling members have been energized by connecting same across the device lead conductors or by utilizing auxiliary potential generators such as a probe, it is highly desirable to include filter elements to filter out any undesired ripple in the generated D.C. potential. Such filter elements are only desirable, however, and are not required as the thermoelectric cooling elements will be operable with D.C. potential which contains a ripple. Some of the foregoing device embodiments have incorporated thermoelectric cooling elements which are adapted to be energized from a separate source of potential. In such embodiments, a separate winding can be included on the ballast for the discharge devices along with the associated rectifier and filter elements, in order to provide the necessary D.C. potential.

Many different embodiments utilizing thermoelectric members in varying fashion have been illustrated and described. Other embodiments are also possible. For example, where the thermoelectric cooling members have been provided with enlarged hot junctions which dissipate heat through radiation, such enlarged hot junctions could be dispensed with and placed in actual contact with heat sinks. Alternatively, where the member hot junctions actually contact heat sinks in the embodiments as illustrated and described, such hot junctions could be provided with radiating surfaces to dissipate heat.

It will be recognized that the objects of the invention have been achieved by providing a discharge device which operates with good efficiency under conditions of high loading or high ambient temperatures or both. There have also been provided constructional details for low-pressure, mercury-vapor discharge devices desired to be operated under such conditions. In addition there have been provided various cooling arrangements and constructions and electrical connections thereto for controlling the mercury-vapor pressure within a low-pressure, mercury-vapor discharge device so that the device operates with high efficiency.

While best-known embodiments have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

We claim:

1. The combination which comprises, radiation-generating means comprising a metallic-vapor discharge device desired to be operated under such conditions as would normally cause the operating metallic-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a thermoelectric cooling member acting when energized to cool a selected location within said generating means to reduce the operating metallic-vapor pressure therein so that it at least approaches the pressure desired.

2. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a thermoelectric cooling member acting when energized to cool a selected location within said generating means to reduce the operating

mercury-vapor pressure therein so that it at least approaches the pressure desired.

3. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and D.C.-operable cooling means positioned within said generating means and comprising a thermoelectric cooling member acting when energized to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

4. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and D.C.-operable cooling means positioned external to said generating means and comprising a thermoelectric cooling member acting when energized to cool a selected portion of said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

5. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a D.C.-operable thermoelectric cooling member having when energized a hot junction and a cold junction, the hot junction of said cooling means adapted to have generated heat removed therefrom, and the cold junction of said cooling means positioned to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

6. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a D.C.-operable thermoelectric cooling member having when energized a hot junction and a cold junction, at least one of the junctions of said thermoelectric member having an enlarged area to improve the thermal transmissive properties thereof, the hot junction of said cooling means adapted to have generated heat removed therefrom, and the cold junction of said cooling means positioned to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

7. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a D.C.-operable thermoelectric cooling member having when energized a hot junction and a cold junction, the hot junction of said thermoelectric member having an enlarged area to improve the thermal transmission therefrom, the hot junction of said cooling means adapted to have generated heat removed therefrom, and the cold junction of said cooling means positioned to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

8. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such con-

ditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a D.C.-operable thermoelectric cooling member having when energized a hot junction and a cold junction, the cold junction of said thermoelectric member having an enlarged area to improve the thermal transmission thereto, the hot junction of said cooling means adapted to have generated heat removed therefrom, and the cold junction of said cooling means positioned to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

9. The combination which comprises, radiation-generating means comprising a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure within said device to exceed the pressure desired, and cooling means associated with said generating means and comprising a D.C.-operable thermoelectric cooling member having when energized a hot junction and a cold junction, the hot junction of said cooling means positioned external to said generating means and adapted to have generated heat removed therefrom, and the cold junction of said cooling means positioned within said generating means to cool a selected location within said generating means to reduce the operating mercury-vapor pressure therein so that it at least approaches the pressure desired.

10. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting phosphor-coated and elongated envelope, lead conductors sealed through each end of said envelope, and electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; and a thermoelectric cooling element associated with said device, said thermoelectric element having when energized a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected location within said device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

11. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and supported by said lead conductors; and a plurality of D.C.-operable thermoelectric elements associated with said device, said thermoelectric elements each having a hot junction and a cold junction, the hot junctions of said thermoelectric elements adapted to have generated heat removed therefrom, and the cold junctions of said thermoelectric elements positioned to cool in predetermined amount selected locations within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

12. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope,

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electrodes operatively disposed at either end of said envelope and supported by said lead conductors; and a separately-energizable thermoelectric element associated with said device, said thermoelectric element having when operated a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

13. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and supported by said lead conductors; and a D.C.-operable thermoelectric element positioned within said device, thermoelectric element lead conductors sealed through said envelope and electrically connecting to said thermoelectric element, said thermoelectric element having when energized a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

14. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, flares sealing off each end of said envelope, lead conductors sealed through said flares at each end of said envelope, and electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; and a thermoelectric element positioned within one of said flares and adapted to have a D.C. potential applied thereacross, said thermoelectric element having when energized a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected portion of said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

15. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, a pair of lead conductors sealed through each end of said envelope, each pair of said lead conductors adapted to have electrical potential applied thereacross during operation of said device, and electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; and a thermoelectric element and a rectifier element electrically connecting across a pair of said lead conductors, said thermoelectric element having when energized a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating

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mercury-vapor pressure within said device at least approaches that pressure desired.

16. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, a pair of lead conductors sealed through each end of said envelope, each pair of said lead conductors adapted to have electrical potential applied thereacross during operation of said device, and electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; and a thermoelectric element and a rectifier element together with associated filter element electrically connecting across a pair of said lead conductors, said thermoelectric element having when energized a hot junction and a cold junction, the hot junction of said thermoelectric element adapted to have generated heat removed therefrom, and the cold junction of said thermoelectric element positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

17. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; and a D.C.-operable thermoelectric element positioned within said device, said thermoelectric element comprising when energized a hot junction and a cold junction, said thermoelectric element hot junction adapted to have generated heat removed therefrom, said thermoelectric cold junction positioned to cool in predetermined amount a selected location within said discharge device; a potential generator comprising a probe and electrical connection to one of said lead conductors, said probe extending into the discharge path of said device proximate the said electrode electrically connected to said one lead conductor, and said thermoelectric element electrically connecting between said probe and said electrical connection to said one lead conductor; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

18. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; a potential generator comprising a thermoelectric element having a junction operable to convert heat into D.C. electric potential, the converting junction of said thermoelectric element positioned to receive heat from a portion of said device when operated; and a D.C.-operable thermoelectric cooling element associated with said device and electrically connecting with said potential generator, said thermoelectric cooling element comprising when energized a hot junction and a cold junction, said thermoelectric cooling element hot junction adapted to have heat removed therefrom, and said thermoelectric cooling element cold junction positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

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19. The radiation-generating combination which includes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; a potential generator comprising a thermoelectric element having a junction operable to convert heat into D.C. electric potential, the converting junction of said thermoelectric element positioned proximate one of said device electrodes to receive heat therefrom; and a D.C.-operable thermoelectric cooling element associated with said device and connecting in series with said potential generator, said thermoelectric cooling element comprising when energized a hot junction and a cold junction, said thermoelectric cooling element hot junction adapted to have generated heat removed therefrom, and said thermoelectric cooling element cold junction positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

20. The radiation-generating combination which in-

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cludes: a low-pressure mercury-vapor discharge device desired to be operated under such conditions as would normally cause the operating mercury-vapor pressure therein to exceed that pressure desired, said device comprising, a radiation-transmitting and elongated envelope, lead conductors sealed through each end of said envelope, electrodes operatively disposed at either end of said envelope and electrically connecting to said lead conductors; a potential generator comprising a thermoelectric element having a junction operable to convert heat into D.C. electric potential, the converting junction of said thermoelectric element positioned proximate one of said device electrodes to receive heat therefrom; and a D.C.-operable thermoelectric cooling element within said device and connecting in series with said potential generator, said thermoelectric cooling element comprising when energized a hot junction and a cold junction, said thermoelectric cooling element hot junction adapted to have generated heat removed therefrom, and said thermoelectric cooling element cold junction positioned to cool in predetermined amount a selected location within said discharge device; whereby the operating mercury-vapor pressure within said device at least approaches that pressure desired.

No references cited.

Notice of Adverse Decision in Interference

In Interference No. 92,663 involving Patent No. 2,932,753, E. G. F. Arnott and R. G. Young, DISCHARGE DEVICE, final judgment adverse to the patentees was rendered Aug. 25, 1965, as to claims 1, 2, 4, 5, 6, 7, 8, 10, 11 and 12.

[Official Gazette February 15, 1966.]