May 21, 1968 J. F. ENGLISH 3,384,774

DECORATIVE PULSATING FLAME INCANDESCENT LAMP

Filed July 9, 1965

Fig. 1.

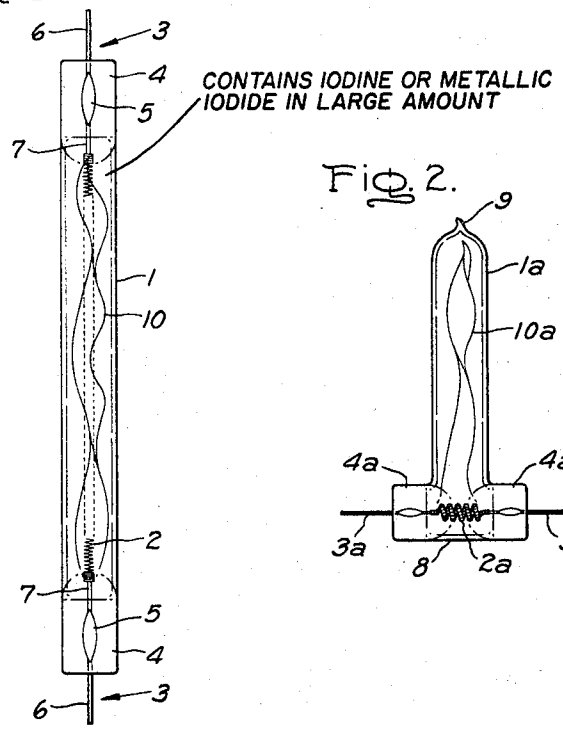
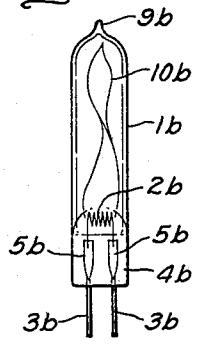


Fig. 2.

Fig. 3.



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DECORATIVE PULSATING FLAME INCANDESCENT LAMP

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ABSTRACT OF THE DISCLOSURE

A luminous pulsating colored flame effect is produced by a vertically oriented tubular incandescent lamp containing a large amount of elemental iodine or vapor of various metallic iodides.

This invention relates generally to electric incandescent lamps comprising a sealed envelope containing an incandescible filament, and has as its principal object the provision of a decorative lamp characterized by the presence of a luminous pulsating colored flame effect.

I have discovered that when an essentially tubular lamp envelope containing an incandescible filament is provided with an atmosphere comprising vapor of various metallic halides or a large amount of elemental iodine at unusually high pressure, and is oriented with the tubular envelope in a vertical position, or at least tilted appreciably from the horizontal, and with at least a significant part of the filament at the lower end of the envelope, upon energization of the filament a luminous pulsating colored flame effect appears in the envelope.

Further features and advantages of the invention will appear from the following detailed description of species thereof and from the drawing wherein: FIGS. 1 to 3 are vertical elevations of different forms of lamp comprising the invention.

Referring to FIG. 1 of the drawing, the lamp illustrated therein comprises a tubular bulb or envelope **1** of vitreous material, preferably quartz (fused silica) or a heat resistant glass of relatively high softening point. The bulb contains a filament **2**, preferably of tungsten wire which may be helically coiled throughout its length, as indicated in the drawing, or which, for smaller wattage sizes, may be helically coiled for a short distance at its lower end (as shown in full lines in FIG. 1) and extend as a relatively straight wire to the upper end of the envelope. The filament **2** is connected at each end to a lead-in conductor **3** which has a portion thereof hermetically sealed in a flattened pinch seal portion **4** at each end of the envelope. When the envelope **1** is made of quartz, the lead-in conductor preferably comprises a thin foil portion **5** which is hermetically sealed in the pinch portion **4**, an outer portion **6** of molybdenum wire, and an inner portion **7** preferably of tungsten wire. When desired, the separate inner wire portion **7** may be omitted and a straightened wire leg portion of the filament wire **2** may be extended into the pinch seal **4** where it is welded to the foil portion **5**. Also, when needed, the filament **2** is additionally supported from the envelope wall by auxiliary support members engaging the filament at spaced points along its length, as is well known in the art.

In the form shown in FIG. 2, the elongated tubular envelope **1***a* is joined to and closed at its lower end by a short transverse tube portion **8** which contains the coiled filament **2***a* at the bottom of the tubular envelope **1***a*. The filament **2***a* is connected to lead-in conductors **3***a* which are sealed through pinch seal portions **4***a* at the ends of the transverse tube portion **8**. The envelope **1***a* is sealed or tipped off at its upper end by the sealed residue of an exhaust tube **9** through which the envelope is evacuated and filled with the desired atmosphere.

In FIG. 3, the envelope **1***b* has a single pinch seal **4***b* at the bottom thereof in which are sealed both the lead-in conductors **3***b*. The coiled filament **2***b* is located at the bottom of the envelope **1***b* and has leg portions thereof extending into the pinch **4***b* and welded to the foil portions **5***b* of the lead-in conductors.

In a particular embodiment, a lamp of the form shown in FIG. 1, having an envelope **1** of about 10 mm. outside diameter, an overall length, including the pinch seals **4**, of about 115 mm., and a helically coiled tungsten wire filament **2** designed to consume about 500 watts at 120 volts, was evacuated and supplied with 0.2 gram of mercuric iodide. In this case, no fill gas was added to the envelope. Upon energization of the filament **2** at voltages as low as about 80 and up to 120 volts, luminous pulsating flames surround the region between the filament and the envelope, as indicated by the flame shape shown at **10**. This reaction goes on indefinitely, and may be due to emission from the mercury and iodine atoms combining after previous dissociation at the high temperature filament.

When the lamp is positioned horizontally, the turbulence disappears, and an orange luminous column exists through which the filament is not visible. A slight tilt of a few degrees from the horizontal position causes a pulse to develop in the luminous column along the lamp axis.

The flame effect has also been produced in lamps containing iodides of other elements such as zinc, titanium, germanium, tin, arsenic and antimony. There are slight differences in the color of the light emitted by the lamp. Arsenic, germanium and mercury iodides all produce a rather red-orange emission. Antimony and thin iodides are similar and less red, i.e., more yellow-white. Titanium iodide, on the other hand is even redder. The color is partly determined by the amount of excess iodine present in the lamp.

The different iodides also produce flames having different rates of movement. For example, the mercury iodide flame appears to move quite rapidly compared to the others.

The flame effect may also be obtained with vapors of iodides of other metals having a low dissociation energy, moderate vapor pressure and strong absorption in the visible specturm. In some cases it may be necessary to adjust the total pressure with some suitable gas, such as argon or hydrogen, for example, to obtain the flame effect with other iodides such as those of bismuth and lead, for example.

It has also been demonstrated that elemental iodine is equal to or in some respects better than iodides for producing the flame effect. The higher vapor pressure and lower boiling point are desirable inasmuch as they permit a lower filament temperature during operation. However, in accordance with the invention, and in contrast to the now conventional iodine cycle illuminating lamp such as disclosed and claimed in Patent 2,883,571 to Fridrich and Wiley, it is necessary to provide a much greater quantity of iodine; in fact the minimum amount of iodine required for this purpose is much greater than the maximum amount (about 1 micromole per cc. of envelope volume) present in lamps of the type disclosed in the said patent. The most effective amount of iodine is dependent upon envelope size and filament temperature; it is readily determined by simple trial in a lamp of given design. The upper limit is determined simply by the maximum gas pressure that the envelope can withstand during operation. In a lamp of the form shown in FIG. 1 and proportioned as described above in connection with mercuric iodide filling, a quantity of at least 50 milligrams of iodine may be placed in the lamp having an envelope volume of about 3.5 cc., with or without additional gas filling such as argon or hydrogen.

The flame effect is present in either a vacuum lamp, or one containing a nonoxidizing gas. The flame effect has been observed for all pressures up to about one atmosphere of either argon or hydrogen, or both, provided the iodine content is sufficiently high. Hydrogen, or a gaseous mixture containing hydrogen, has the advantage of increased envelope wall temperature for a given filament voltage, thereby tending to avoid condensation of iodine in the remote and cooler regions of the envelope, especially in lamp designs of the type shown in FIGS. 2 and 3.

In a lamp of the form shown in FIG. 2 and containing either elemental iodine or metallic iodide, with or without a supplementary gas filling, the filament **2***a* may be a coiled coil of tungsten wire designed for operation at 200 watts with a current of 6.6 amperes, in an envelope **1***a* of 10 mm. outside diameter and 50 mm. length, the transverse tube portion **8** having a diameter of 10 mm. and an overall length, including the seals **4***a*, of 25 mm.

The lamp shown in FIG. 3 may have an envelope **1***b* of 10 mm. diameter and 50 mm. overall length, and contain a helical filament coil **2***b* of five turns for operation at 8.5 volts with a power consumption of 60 watts.

It may be noted, particularly with lamps of the type shown in FIGS. 2 and 3 where the filament is located at the lower end only of the envelope, that it is necessary that the envelope temperature be sufficiently high at all points of its interior to at least keep the iodine molten so that it can run back down to the bottom of the envelope. There must be no configuration providing a pocket, such as a significant lateral extension, in which the iodine can collect and thereby deplete the effective vapor supply. Similarly, the envelope **1***a* or **1***b* must not be so long that its temperature is so low that the iodine will condense and settle out in the upper end thereof. Accordingly, the interior envelope wall should have a minimum temperature, at any point, at least above the melting point of iodine (i.e., above about 130° C.), and preferably above about 250° C. to insure proper operation, and the iodine content should be at least about 15 milligrams per cubic centimeter of envelope volume, whether the iodine is present in elemental form only or as part of a metallic iodide such as referred to above.

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

1. An electric incandescent lamp comprising a sealed envelope of essentially tubular form adapted for orientation in a position inclined from the horizontal during operation of the lamp, an incandescible filiment having at least a significant portion thereof located at the base of said envelope, said envelope proportioned to attain a minimum temperature at any area of its inner walls of about 250° C., and means to supply in said envelope an atmosphere of the class consisting of vapor of elemental iodine and metallic iodides and mixtures thereof in an amount of at least about 15 milligrams iodine content per cc. of envelope volume and sufficient to produce a luminous pulsating colored flame effect in the inclined envelope upon energization of the filament.

2. An electric incandescent lamp comprising a sealed envelope of essentially tubular form adapted for orientation in a position inclined from the horizontal during operation of the lamp, an incandescible filament having at least a significant portion thereof located at the base of said envelope, said envelope proportioned to attain a minimum temperature at any area of its inner walls of about 250° C., and means to supply in said envelope an atmosphere of the class consisting of vapor of elemental iodine and iodide of at least one of the metals mercury, gold, zinc, tin, arsenic, antimony, bismuth and lead and mixtures thereof in an amount of at least about 15 milligrams iodine content per cc. of envelope volume and sufficient in amount to produce a luminous pulsating colored flame effect in the inclined envelope upon energization of the filament.

3. An electric incandescent lamp comprising a sealed envelope of essentially tubular form adapted for orientation in a position inclined from the horizontal during operation of the lamp, an incandescible filament having at least a significant portion thereof located at the base of said envelope, said envelope proportioned to attain a minimum temperature at any area of its inner walls of about 250° C., and means to supply in said envelope an atmosphere of elemental iodine vapor of at least about 15 milligrams per cc. of envelope volume and sufficient to produce a luminous pulsating colored flame effect in the inclined envelope upon energization of the filament.

4. An electric incandescent lamp comprising a sealed envelope of essentially tubular form adapted for orientation in a position inclined from the horizontal during operation of the lamp, an incandescible filament having at least a significant portion thereof located at the base of said envelope, said envelope proportioned to attain a minimum temperature at any area of its inner walls of about 250° C., and means to supply in said envelope an atmosphere of vapor of iodide of at least one of the metals mercury, gold, zinc, tin, arsenic, antimony, bismuth and lead in an amount of at least about 15 milligrams of iodine content per cc. of envelope volume and sufficient to produce a luminous pulsating colored flame effect in the inclined envelope upon energization of the filament.

5. An electric incandescent lamp comprising a sealed envelope of essentially tubular form adapted for orientation in a position inclined from the horizontal during operation of the lamp, an incandescible filament having at least a significant portion thereof located at the base of said envelope, said envelope proportioned to attain a minimum temperature at any area of its inner walls of about 250° C., and means to supply in said envelope an atmosphere of the vapor of mercuric iodide in an amount of at least about 15 milligrams of iodine content per cc. of envelope volume and sufficient to produce a luminous pulsating colored flame effect in the inclined envelope upon energization of the filament.

6. A lamp as set forth in claim **1** wherein the envelope also contains a filling of nonoxidizing gas.

7. A lamp as set forth in claim **1** wherein the envelope also contains a filling of hydrogen gas.

8. A lamp as set forth in claim **3** wherein the lamp also contains a filling of hydrogen gas.

References Cited

FOREIGN PATENTS

952,938 3/1964 Great Britain.

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