(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 140 330**
B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **04.01.89**

(51) Int. Cl.[4]: **H 01 K 1/14**, H 01 K 1/50

(21) Application number: **84112780.6**

(22) Date of filing: **23.10.84**

(54) Miniature incandescent lamp.

(30) Priority: **31.10.83 JP 202653/83**

(43) Date of publication of application:
08.05.85 Bulletin 85/19

(45) Publication of the grant of the patent:
04.01.89 Bulletin 89/01

(84) Designated Contracting States:
DE FR GB IT NL

(56) References cited:
FR-A- 785 139
US-A-2 891 189
US-A-4 208 609

(73) Proprietor: **KABUSHIKI KAISHA TOSHIBA**
72, Horikawa-cho Saiwai-ku
Kawasaki-shi Kanagawa-ken 210 (JP)

(72) Inventor: **Nieda, Yasuhiro c/o Patent Division**
KABUSHIKI KAISHA TOSHIBA 1-1 Shibaura 1-chome
Minato-ku Tokyo 105 (JP)
Inventor: **Honda, Kiyokazu c/o Patent Division**
KABUSHIKI KAISHA TOSHIBA 1-1 Shibaura 1-chome
Minato-ku Tokyo 105 (JP)

(74) Representative: **Blumbach Weser Bergen Kramer Zwirner Hoffmann Patentanwälte**
Radeckestrasse 43
D-8000 München 60 (DE)

EP 0 140 330 B1

Courier Press, Leamington Spa, England.

Description

The present invention relates to a miniature incandescent lamp and, more particularly, to an improvement in lamp characteristics.

Basic requirements for miniature incandescent lamps used in cars or the like are luminous efficacy (lm/W) and increased life expectancy. It is ideal to increase the luminous efficacy and prolong the life of the lamp. However, in a conventional miniature incandescent lamp, when the luminous efficacy is increased, its life is shortened. This is because filament evaporation becomes active when a filament temeprature is increased to increase the luminous flux, thereby disconnecting the filament at an early period and blackening the bulb wall.

In a covnentional lamp, an inert gas is filled in a bulb to decrease filament evaporation, and a greater effect can be obtained when the molecular weight of the filled gas is larger. For example, a filament temperature of a lamp sealing krypton gas can be higher than that of a lamp filling argon gas and has a lower filling gas loss than the lamp filling argon gas. In addition, when xenon is mixed with krypton, the above-mentioned effect can be typically reinforced, as described in Japanese Utility Model Publication No. 54—2068.

Xenon has a lower ionization voltage than those of argon and krypton. When a high content of xenon is filled in the bulb, an arc discharge occurs between coil turns of the filament, and the filament is burnt out. In a general-purpose illumination incndescent lamp having ratings of 100 V (100 W) and described in the above publication, the ratio of xenon to krypton is reduced to 5 to 10.4% by volume. In addition, nitrogen is mixed in a gas mixture of krypton and xenon to increase an arc discharge starting voltage. However, when the xenon content is low and the content of nitrogen is high, the effect of xenon is impaired.

Demand has arisen for a miniature incandescent lamp to obtain the effect of xenon, to provide high luminous efficacy and increased life expectancy properties, and to prevent an arc discharge in the lamp.

A conventional halogen lamp is known as an incandescent lamp having high luminous efficacy and long life. However, the bulb wall temperature must be increased to activate the halogen cycle in the halogen lamp. For this purpose, hard glass such as quartz or aluminosilicate glass having high heat resistance must be used as a bulb material. However, hard glass is expensive and is difficult to work with. In particular, when a miniature lamp has a lamp power of less than 8 W, the bulb must be extremely minuaturized to increase the bulb wall temperature. As a result, the manufacturing process becomes complicated, and hard glass, which is difficult to work with, cannot be used. In addition, when the lamp size is decreased, it is difficult to control and fill the proper amount of halogen gas in the lamp. When the lamp is minuaturized, the filament coil wire must be thinner. The life of the lamp becomes shortened due to a chemical reaction between the halogen gas and the thin coil wire. Therefore, a miniature halogen lamp involves difficult manufacturing techniques and results in high cost.

US—A—2 891 189 discloses an gas-filled electric incandescent lamp filled with nitrogen and xenon, wherein the xenon may be pure xenon or a gas mixture containing xenon as an constituent of at least about 80% by volume. One feature of this prior art lamp is that the minimum distance between the nearest points of highest potential difference of the filament depends on the rated voltage of the lamp, the rated energy consumption of the lamp, the luminous efficiency and a certain numerical factor.

US—A—4 208 609 discloses an incandescent lamp in which a ratio defined by the center to center spacing of the turns of the filament, divided by the diameter of the filament is between 1,4 and 1,8. If this ratio is transformed to a value defined by the spacing between facing sides of two adjacent turns of the filament, divided by the diameter of the filament, there is obtained a value between 0.4 and 0.8.

However, if a gas having a low arc discharge starting voltage is used, arc discharge instantly takes place between turns when the above ratio is in the range of 0,4 to 0,8.

The object of the present invention is to provide a miniature incandescent lamp, which shows high luminous efficacy and long life and which prevents an arc discharge between turns of a coiled filament.

A miniature incandescent lamp of the present invention comprises a glass bulb containing an inert gas therein and a coiled filament arranged in the bulb. The inert gas contains xenon and nitrogen. A content of xenon in the inert gas is 80% b volume or more. A pitch ratio p/d of a coil pitch (spacing between two adjacent coil turns) p to a wire diameter d is 1.4 or more.

When the content of xenon is less than 80% by volume, the effect of xenon cannot be obtained, and a lamp have high luminous efficacy and long life cannot be obtained.

The xenon content preferably falls within the range of 90 and 98% by volume.

A nitrogen content preferably falls within the range of 2 and 10% by volume so as to obtain the effect of xenon and prevent the arc discharge.

When the ratio p/d is larger, the effect of preventing the arc discharge can be improved. However, in practice, the upper limit of the pitch ratio is 2.0. The ratio p/d preferably falls within the range of 1.4 and 1.8.

The inert gas filled in the lamp of the present invention is not limited to xenon and nitrogen. The inert gas may contain argon and/or krypton.

The application of the lamp according to the present invention is not limited to use in vehicles but can be extended to decorative illuminations for home use.

The lamp base is not limited to be of a wedge type but can be of an Edison type.

A material for the lamp bulb according to the present invention may comprise soft glass or hard glass.

A large amount of xenon having high molecular weight (i.e., a low thermal conductivity coefficient) is filled in the bulb of the lamp of the present invention, so that low-cost soft glass having good workability can be adapted.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of a wedge base type miniature incandescent lamp;

Fig. 2 shows a filament of the lamp shown in Fig. 1; and

Fig. 3 is a graph showing the relationship between the ratio p/d of a coil pitch p to a wire diameter d and the arc discharge starting voltage.

A miniature incandescent lamp shown in Fig. 1 comprises a wedge base type lamp having ratings of 12 V (5 W). A bulb 1 comprises soft glass such as lead glass or soda-lime glass. A tungsten filament 2 is mounted in the bulb 1 and is connected to lead wires 3. The lead wires 3 are sealed at a pinch-sealed portion 4 and extend outside therefrom. Lead-out portions 6 of the lead wires 3 are folded along the side surfaces of the pinch sealed portion 4. The central portion of the filament 2 is supported by an anchor wire 5.

A gas mixture of xenon gas and nitrogen gas, which has a volume ratio of 95:5, is filled in the bulb 1 at a total pressure of 79992 Pa (600 Torr).

The filament 2 comprises a single coil made of a tungsten wire. A ratio p/d of a coil pitch (spacing between coil turns) p (mm) to a wire diameter d (mm) shown in Fig. 2 is given as 1.8.

The specifications of the lamp of the present invention and the conventional miniature incandescent lamp are summarized below.

Table

	Rated power	Filling gas	Color temperature (K)	Luminou flux (ℓm)	Life-expectancy (hr)
Prior art	12 V 5 W	Vacuum	2,540	50	380
	12 V 5 W	Argon 95% Nitrogen 5%	2,650	50	400
Present invention	12 V 5 W	Xenon 95% Nitrogen 5%	2,850	65	1,000

As is apparent from the above table, the color temperature , luminous flux and life of the miniature incandescent lamp of the present invention are better than those of the conventional lamp.

When 100% of xenon gas is filled in the bulb, the convection loss of the gas is decreased, so that the luminous flux after 100 hours can be more than 70 lm. As previously described, however, xenon has a low ionization voltage, and an arc discharge tends to occur between the coil turns of the filament. For example, when a 12 V, 5 W type lamp is used, an arc discharge starting voltage becomes as low as 14.5 V (ratio at the rated voltage is 1.2). However, when the volume content of xenon gas in the filling gas becomes less than 80%, the arc discharge starting voltage is increased. The luminous flux after 1,000 hours becomes 55 lm or less. In this manner, the effect of xenon gas is extremely impaired.

According to the present invention, the volume % of xenon gas is kept at 80% or more, and the effect of xenon gas is maintained. In addition, nitrogen gas is mixed in xenon gas and the ratio p/d of the coil pitch p to the wire diameter d is kept to be 1.4 or more, thereby preventing a decrease in the arc discharge starting voltage.

The present inventors made an experiment to clarify the relationship between the ratio p/d and the arc discharge starting voltage in a 12 V, 5 W type miniature incandescent lamp. Results are shown in Fig. 3.

As is apparent from the graph in Fig. 3, it is found that the arc discharge starting voltage becomes sufficiently high when the ratio p/d us 1:4 or more. However, when the ratio p/d becomes less than 1.4, the electric field strength between the coil turns is increased, so that the arc discharge tends to occur. As described above, when the ratio p/d is 1.4 or more, however, the electric field strength between the coil turns is descreased. As a result, the arc discharge will not substantially occur.

As has been described above, according to the miniature incandescent lamp of the present invention, since the inert gas contains 80% by volume or more of xenon, the gas loss becomes small and the liminous efficacy is improved. The filament evaporation of the lamp can be decreased to provide long life. Furthermore, nitrogen is mixed in xenon, and the ratio p/d of the filament is 1.4 or more. Therefore, the arc discharge will not occur between the turns of the coiled filament. Soft glass is used as the bulb material, so that the lamp can be easily manufactured at low cost.

Claims

1. A miniature incandescent lamp comprising a glass bulb (1) containing an inert gas therein and a coiled filament (2) arranged in said bulb (1), the inert gas containing xenon and nitrogen, the content of xenon in the inert gas being not less than 80% by volume, characterized in that the pitch ratio p/d of the spacing p between two adjacent turns of the coiled filament (2) to the wire diameter d is not less than 1.4.

2. A lamp according to claim 1, characterized in that the content of xenon falls within the range of 90% by volume to 98% by volume.

3. A lamp according to claim 1 or 2, characterized in that the content of nitrogen falls within the range of 2% by volume to 10% by volume.

4. A lamp according to claim 1, 2 or 3, characterized in that the inert gas further contains at least one material selected from the group consisting of argon and krypton.

5. A lamp according to any of claims 1 to 4, characterized in that the ratio p/d falls within the range of 1.4 to 2.0.

6. A lamp according to claim 5, characterized in that the ratio p/d falls within the range of 1.4 to 1.8.

7. A lamp according to any of claims 1 to 6, characterized in that said bulb comprises soft glass.

Patentansprüche

1. Miniaturglühlampe, umfassend eine ein inertes Gas enthaltende Glasbirne (1) und einen in der Birne (1) angeordneten, gewickelten Faden (2), wobei das inerte Gs Xenon und Stickstoff enthält und der Anteil von Xenon in dem inerten Gas nicht weniger als 80 Vol.-% beträgt, dadurch gekennzeichnet, daß das Teilungerverhältnis p/d des Abstands p zwischen zwei benachbarten Windungen des gewickelten Fadens (2) und dem Drahtdurchmesser d nicht weniger als 1,4 beträgt.

2. Lampe nach Anspruch 1, dadurch gekennzeichnet, daß der Xenon-Anteil in den Bereich von 90 Vol.-% bis 98 Vol.-% fällt.

3. Lampe nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Stickstoffanteil in den Bereich von 2 Vol.-% bis 10 Vol.-% fällt.

4. Lampe nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß das inerte Gas weiterhin mindestens ein Material enthält, das aus der aus Argon und Krypton bestehenden Gruppe ausgewählt ist.

5. Lampe nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß das Verhältnis p/d in den Bereich von 1,4 bis 2,0 fällt.

6. Lampe nach Anspruch 5, dadurch gekennzeichnet, daß das Verhältnis p/d in den Bereich von 1,4 bis 1,8 fällt.

7. Lampe nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Birne Weichglas enthält.

Revendications

1. Lampe à incandescence miniature comprenant une ampoule de verre (1) contenant un gaz inerte et un filament spiralé (2) disposé dans ladite ampoule (1), le gaz inerte contenant du xénon et de l'azote, la teneur en xénon du gaz inerte n'étant pas inférieure à 80% en volume, caractérisé en ce que le rapport d'écartement p/d de l'écartement *p* entre deux spires adjacentes du filament spiralé (2) au diamètre *d* du fil n'est pas inférieur à 1,4.

2. Lampe selon la revendication 1, caractérisée en ce que la teneur en xénon s'établit dans l'intervalle de 90% en volume à 98% en volume.

3. Lampe selon la revendication 1 ou 2, caractérisée en ce que la teneur en azote s'établit dans l'intervalle de 2% en volume à 10% en volume.

4. Lampe selon la revendication 1, 2 ou 3, caractérisée en ce que le gaz inerte contient en outre au moins une matière choisie dans le groupe formé de l'argon et du krypton.

5. Lampe selon l'une quelconque des revendications 1 à 4, caractérisée en ce que le rapport p/d s'établit dans les limites de 1,4 à 2,0.

6. Lampe selon la revendication 5, caractérisée en ce que le rapport p/d s'établit dans les limites de 1,4 à 1,8.

7. Lampe selon l'une quelconque des revendications 1 à 6, caractérisée en ce que l'ampoule est constituée de verre tendre.

FIG. 1

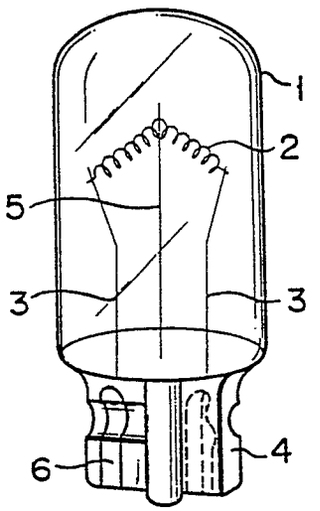


FIG. 2

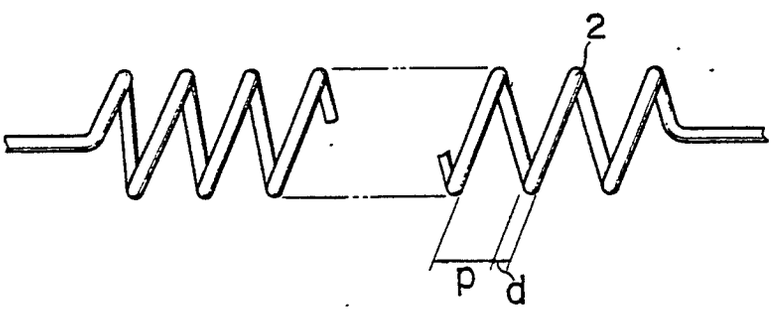
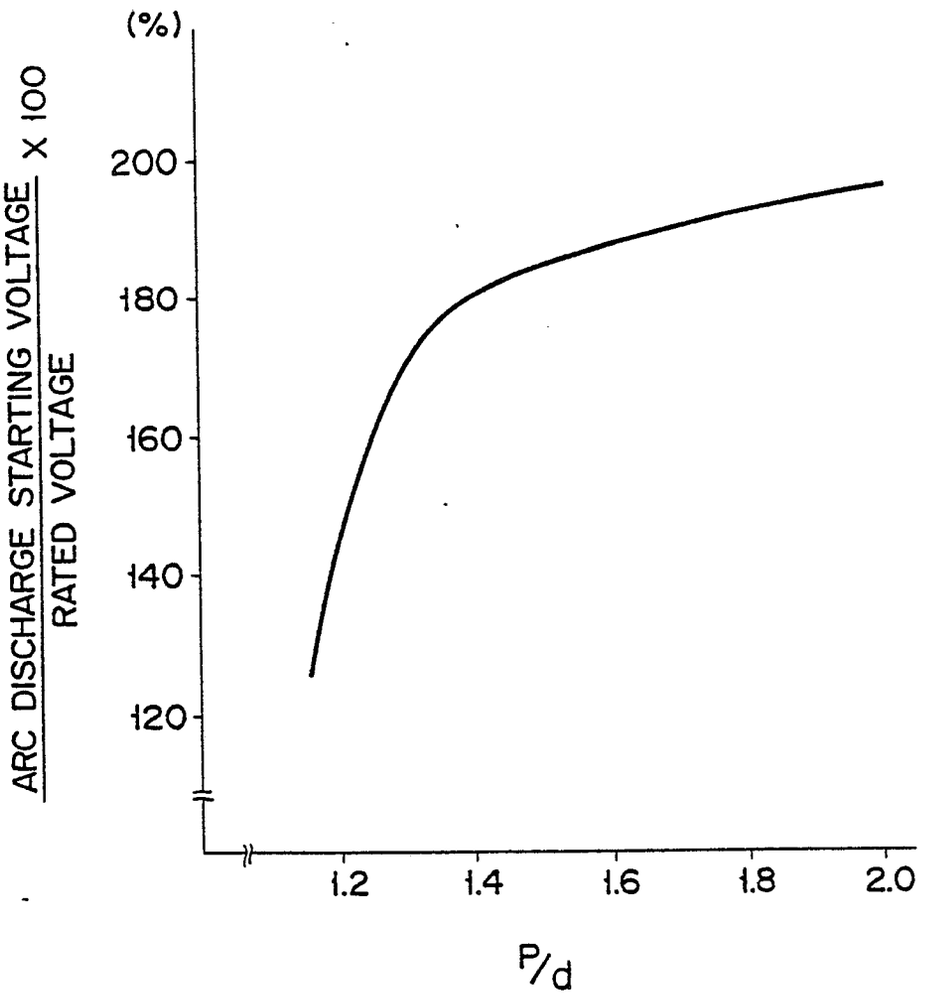


FIG. 3


(%)
ARC DISCHARGE STARTING VOLTAGE / RATED VOLTAGE X 100
200
180
160
140
120
1.2
1.4
1.6
1.8
2.0
P/d