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ELECTRIC LAMPS

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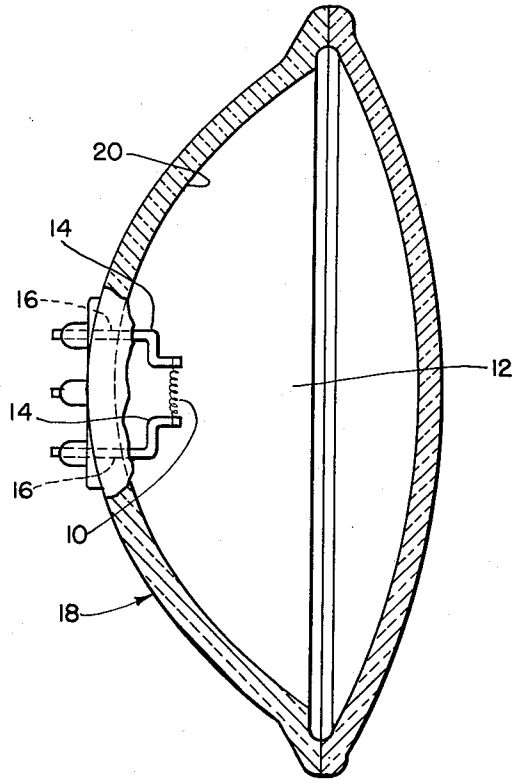

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ELECTRIC LAMPS

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This invention relates to electric lamps and more particularly to new and improved electric incandescent lamps adapted to be operated at relatively high temperatures and possessing relatively long, useful operating life at such high temperatures.

Objects of the invention are to provide incandescent lamps of the character described in which a filament comprising a major percentage of tantalum carbide is positioned within the envelope of the lamp containing an atmosphere comprising, at operating temperatures, hydrogen, vaporized carbon and at least two halogens, one of the halogens being selected from the group consisting of bromine and iodine.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the product possessing the features, properties, and the relation of elements which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, which is a representation of a section through a typical automobile headlight embodying the features of the invention.

In the copending application Serial No. 840,495, filed September 10, 1959, there are disclosed electric incandescent lamps constructed with a tantalum carbide filament mounted within an atmosphere comprising, at operating temperatures, hydrogen, vaporized carbon, and a halogen, such as chlorine, fluorine, or bromine. The lamp may also contain an inert gas such as argon, krypton or xenon. It has been found that improved operating life in incandescent lamps of the type disclosed in the copending application can be obtained by including therewithin, at operating temperatures, a second halogen, more particularly iodine or bromine. Thus, the preferred incandescent lamp comprises a filament comprising a major percentage of tantalum carbide positioned within an atmosphere comprising, at operating temperatures, hydrogen, vaporized carbon and at least two halogens, such as for example chlorine and iodine, chlorine and bromine, bromine and iodine and the like.

In one preferred embodiment of this invention, shown in the drawing, a filament **10** comprising a major percentage of tantalum carbide is positioned within an atmosphere **12** comprising, at operating temperatures, hydrogen, volatilized carbon, and at least two halogens, one of which is iodine or bromine. An inert gas such as argon may also be present within the atmosphere. The components of the atmosphere may be provided by introducing, for example, carbon tetrachloride, methyl iodide or bromide and hydrogen before the bulb is sealed. The filament **10** may be suspended between leads **14** which are in turn attached to subleads **16**; the subleads may be connected to a source of electric power outside the envelope **18**. In one preferred embodiment the filament may be mounted on 40 mil tantalum carbide leads within a standard T-20 envelope of about 270 cc. capacity into which about 2 cc. of carbon tetrachloride, a small amount of methyl iodide and 20 cc. of hydrogen, at atmospheric pressure and room temperature, have been introduced, along with sufficient argon to bring the total pressure within the bulb at least to slightly less than one atmosphere. The bulb and components may be cleaned and prepared in ways well known to the art. It is desirable to coat the inner surface **20** of the envelope with a material that will protect the glass from attack. This may be done by evaporating calcium fluoride, for example, upon the inner surface of the envelope before the lamp is assembled.

The filaments employed are comprised of a major percentage or portion of tantalum carbide. The filaments may consist essentially of tantalum carbide, such as disclosed in U.S. Patent 2,596,469, or they may be comprised of a solid solution or mixture of a major percentage of at least one refractory metal carbide such as disclosed in copending applications Serial Nos. 5,524 and 5,525, both filed January 29, 1960. In the former application, there is disclosed and claimed the use of a filament comprising tantalum carbide and from about 1 to about 30 percent by weight of at least one metal carbide selected from the group consisting of the carbides of zirconium and hafnium. In the latter-mentioned application, there is disclosed and claimed the use of a filament comprising tantalum carbide and between about 1 and 10 percent by weight of at least one metal carbide selected from the group consisting of the carbides of titanium, thorium, vanadium, niobium, tungsten, molybdenum and uranium.

The filament may be of any suitable configuration, whether straight, coiled, crimped or otherwise shaped. Although any convenient method of forming the carbide filament (or leads) may be used, it may be convenient to convert, for example, a tantalum filament and leads to tantalum carbide after the bulb has been assembled. For example, a bulb may be constructed with all elements identical with those disclosed in the preferred embodiment of this invention, except that the filament and leads may comprise essentially pure tantalum. The filament may then be converted to tantalum carbide by passing sufficient current through the filament to yield a filament temperature of about 3100° C. In this way, the filament and lead ends associated with it will be substantially converted to tantalum carbide.

Many materials may be used for leads. For example, the leads may consist of a composition similar to the filament or they may consist of rods of carbon, tungsten, platinum, palladium, rhodium, or suitable metals coated or plated with platinum, palladium, rhodium and the like.

Heretofore, incandescent lamps have been proposed which employed an atmosphere the elements of which interacted with each other and with the filament so as to provide for increased lamp life. For example, there have been disclosed incandescent lamps employing a filament comprising a major percentage of tantalum carbide within atmospheres including, in addition to hydrogen and volatilized carbon, chlorine or fluorine. In such incandescent lamps, it has been observed that uncombined carbon is deposited at the ends of the filaments and leads which are at a temperature below the operating temperature of the filament. This causes the equilibrium systems to become unbalanced, such that the amount of carbon in the atmosphere is insufficient to prevent the metal carbide filament from decomposing into free metal and carbon. The decarburized filament is then subject to more rapid deterioration and failure. It has been found that in incandescent lamps of the above-mentioned type, the deposit of uncombined carbon at the cooler portions of the filament structure can be substantially reduced and the filament and lamp life greatly extended by including within the atmosphere at least one

source of a halogen selected from the group consisting of bromine and iodine. This may be explained on the basis that the temperatures at the ends of the filament and leads during lamp operation are sufficient to thermally decompose hydrogen iodide or hydrogen bromide to a substantial extent so as to provide adequate hydrogen and iodine or bromine to combine with the carbon in these areas whereas these temperatures are insufficient to appreciably decompose the more stable hydrogen halides, hydrogen chloride and hydrogen fluoride. The preferred incandescent lamp atmosphere therefore comprises at least one source of: hydrogen, volatilized carbon, a halogen selected from the group consisting of chlorine, bromine and fluorine and a halogen selected from the group consisting of bromine and iodine.

The preferred atmosphere may be provided by a number of materials or sources. For example, the necessary elements may be provided by introducing into the atmosphere a combination of materials. For instance, the atmosphere may be provided by the use of compounds such as ethylenediamine hydrochloride or methylamine hydrochloride and the like, with bromine or iodine or a compound thereof, e.g., methyl bromide or iodide. Also, the atmosphere may be provided by utilizing materials such as ethylene or another hydrocarbon and a gaseous hydrogen halide, e.g., hydrogen chloride with, for example, bromine or iodine or a compound thereof, e.g., ethyl bromide, or iodide, hydrogen iodide, etc. Likewise, there may be used a combination of hydrogen, any convenient hydrocarbon, e.g., ethane, methane, ethylene and the like, and a mixture of halogens, e.g., chlorine and iodine. A combination of iodine or bromine or a compound thereof, hydrogen and any appropriate halogenated hydrocarbon such as benzene hexachloride, the appropriate halogen derivatives of methane, ethane, etc., e.g., carbon tetrachloride, carbon tetrabromide, tetrachloroethane and the like is satisfactory. Likewise, a combination of iodine or bromine or a compound thereof, hydrogen, and polyhalogenated organic compounds such as tetrachloroethylene and the like may also be utilized. Mixed polyhalogenated organic compounds such as, for example, dibromochloromethane, trichlorobromomethane, trichloroiodomethane, and the like, and hydrogen, may also be employed. It is obvious that the desired atmosphere thus may be obtained in any number of suitable ways. Other inert gases, such as xenon or krypton, may be used instead of argon.

Relatively high pressures within the bulb will lengthen lamp life; it is desirable to maintain the pressure during operation at or near the highest level that the envelope can safely withstand. If the pressure generated by the reacting gases is great enough, the need for an inert gas is reduced.

If fluorine is used, precautions must be taken to avoid decomposition of the bulb envelope and attack upon other lamp elements. If elemental halogens are used in preparing the lamp atmosphere, precautions should be taken to avoid inhalation or contact with the skin and eyes.

In general, any combination of materials may be used that will provide, at operating temperatures, an atmosphere of volatilized carbon, hydrogen, at least two halogens, one of which being either bromine or iodine, in the area surrounding the filament. The atmosphere should be substantially free of water or oxygen; specifically, the oxygen content should be less than the order of 50 parts per million. The amount of carbon in the atmosphere should be sufficient to prevent the carbide filament from decomposing into free metal and carbon. Hydrogen and halogens may be used in varying proportions; it is critical only that enough hydrogen be present to prevent the halogens from attacking the bulb components, and that the total amount of hydrogen and halogens be sufficient to combine with carbon atoms in all regions surrounding the filament to reduce or eliminate the deposits of uncombined carbon particularly upon the cooler portions of the filament structure. Thus the atmosphere within the envelope preferably comprises an excess by volume of halogens and hydrogen over vaporized carbon and an excess by volume of hydrogen over halogens.

While the drawing particularly describes the application of the present invention to vehicle lamps, it is understood that the invention may be advantageously employed generally with incandescent lamps, for example, photoflood lamps and related structures adapted to project carefully controlled or substantially collimated light beams.

Moreover, while the drawing describes a specific lamp configuration or structure, it is understood that the incandescent lamp may take any desired shape and have any desired size. It may, for example, have an envelope which is either transparent or translucent in whole or in part; and where a portion only of the envelope is light transmitting, the remainder may comprise a parabolic or other suitable reflector with the lamp filament positioned at the focus thereof.

Since certain changes may be made in the above products without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In an incandescent lamp, a filament comprising a major percentage of tantalum carbide positioned within an atmosphere comprising, at operating temperatures, hydrogen, vaporized carbon and at least two halogens, one of said halogens being selected from the group consisting of iodine and bromine, said atmosphere being substantially free of oxygen.

2. A lamp according to claim 1 wherein the atmosphere comprises an excess by volume of halogens over vaporized carbon.

3. A lamp according to claim 1 wherein the atmosphere also comprises an inert gas of low heat conductivity.

4. A lamp according to claim 1 wherein the atmosphere comprises an excess by volume of halogens over vaporized carbon and an excess by volume of hydrogen over halogens.

5. A lamp according to claim 1 wherein said halogens comprise chlorine and iodine.

6. A lamp according to claim 1 wherein said halogens comprise chlorine and bromine.

7. A lamp according to claim 1 wherein one of said halogens is selected from the group consisting of iodine and bromine and the other of said halogens is selected from the group consisting of chlorine and fluorine.

8. In an incandescent lamp, a filament comprising a major percentage of tantalum carbide positioned within an atmosphere comprising hydrogen, carbon and at least two halogens, one of said halogens being selected from the group consisting of iodine and bromine.

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