

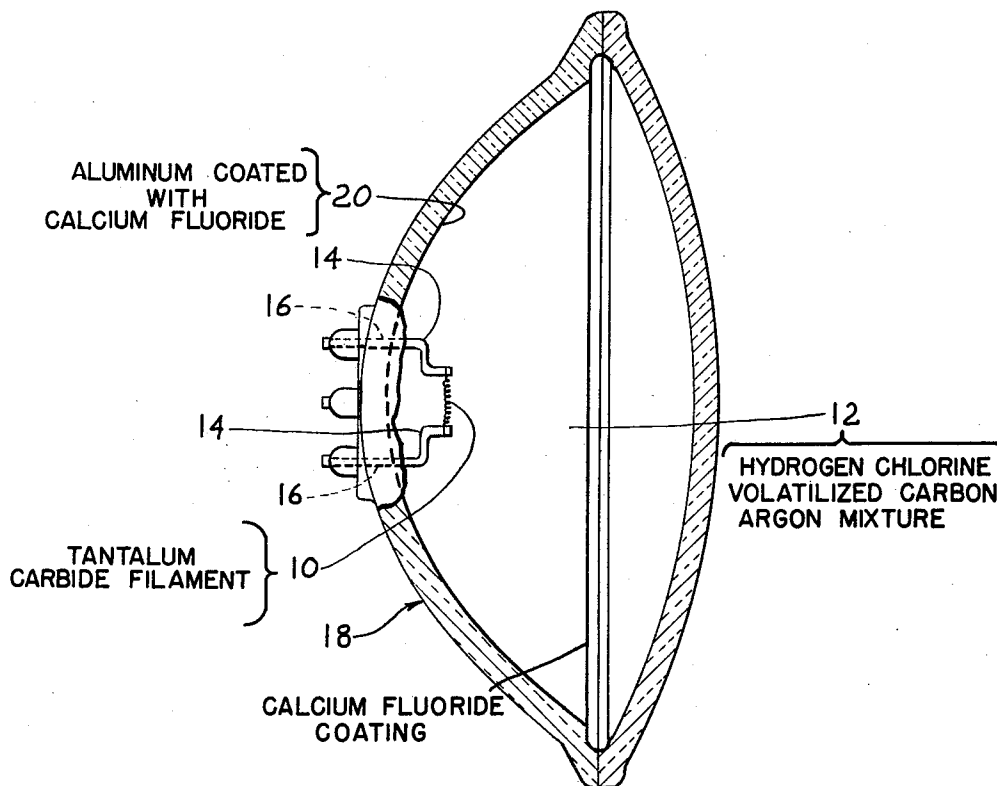
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ELECTRIC LAMPS

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ELECTRIC LAMPS

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

This application is a continuation-in-part of my co-pending application Serial No. 559,394, filed January 16, 1956, now abandoned.

Objects of the invention are to provide incandescent lamps of the character described in which the filament consists essentially of tantalum carbide and in which the envelope of the lamp contains an atmosphere comprising, at operating temperatures, an inert gas, hydrogen, carbon, and a halogen, such as chlorine, fluorine or bromine.

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 headlamp embodying the features of the invention.

Present-day electric incandescent lamps are generally constructed with a tungsten filament mounted in an evacuated atmosphere within the bulb or in an atmosphere comprising essentially inert gases. These inert gases may, for example, comprise a mixture of gases of which the major portion is argon, krypton or xenon. Inert gases are employed to reduce evaporation of the filament during lamp operation. Nevertheless, a common cause of lamp failure is evaporation of filament material to such an extent that the filament is gradually eaten away and fails. Since the rate of evaporation varies directly with the temperature, this kind of failure is especially prevalent in bulbs designed to operate at very high temperatures. Rapid filament evaporation has long been a serious problem in incandescent lamp manufacture, since the efficiency of the bulb as a source of illumination measured in candle power per watt, for example, generally increases as the operating temperature of the filament is raised.

This invention accordingly contemplates the use of an atmosphere the elements of which interact with each other and with a tantalum carbide filament in such a manner that the filament does not deteriorate over an extended period of operation at high filament temperatures. The invention thus yields a lamp that has both long operating life and high efficiency.

In the preferred embodiment of this invention, shown in one application in the drawing, a tantalum carbide filament 10 is positioned within an atmosphere 12 comprising, at operating temperatures, hydrogen, chlorine, and volatilized carbon, together with an inert gas such as argon. The components of the atmosphere may be provided by introducing hexachlorobenzene, for example, before the bulb is sealed. The filament 10 may be suspended between tantalum carbide leads 14 which are in turn attached to nickel subleads 16; the subleads may be connected to a source of electric power outside the

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envelope 18. In one preferred embodiment, the filament seven mils in diameter and about one-half inch in length may be mounted on 40-mil tantalum carbide leads within a standard T-20 envelope of about 270 cc. capacity, into which about 2.75 mg. hexachlorobenzene and 20 cc. 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 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 filament may be of any suitable configuration, whether straight, coiled, crimped, or otherwise shaped. Although any convenient method of forming a tantalum carbide filament or leads may be used, it may be convenient to convert a tantalum filament and leads to tantalum carbide after the bulb has been assembled. For example, the 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 baking the bulb at about 300° C. for about 15 minutes, with sufficient current passing 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. Tests show that it is unnecessary to carbide the remaining portions of the leads.

Many other materials may be used for leads. For example, rods made of carbon, tungsten or gold plated nickel have proved satisfactory.

The proper atmosphere may be provided by a number of materials or sources. For example, single compounds, such as ethylenediamine hydrochloride, methylamine hydrochloride and the like are satisfactory. The necessary elements may also be provided by introducing into the atmosphere a combination of materials, such as ethylene or another hydrocarbon and a gaseous hydrogen halide, e.g. hydrogen chloride; or a combination of hydrogen, chlorine and any convenient hydrocarbon, e.g. methane, ethane, ethylene and the like; or a combination of hydrogen and any convenient halogenated hydrocarbon such as benzene hexachloride, the polyhalogen derivatives of methane, ethane, etc., e.g. carbon tetrachloride, tetrachloroethane and the like; or a combination of hydrogen and polyhalogenated organic compounds such as tetrachloroethylene and the like. 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.

Other halogens may be used in place of chlorine without departing from the invention; members of the class of halogens having an atomic weight of less than 100 are especially effective. If fluorine is used, however, 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 skin and eyes.

In general, any combination of materials may be used that will provide, at operating temperatures, an atmos-

phere of volatilized carbon, hydrogen, and a suitable halogen, preferably chlorine, 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 five parts per million. The amount of carbon in the atmosphere should be sufficient to prevent the tantalum carbide filament from decomposing into free tantalum and carbon. Hydrogen and chlorine may be used in varying proportions; it is critical only that enough hydrogen be present to prevent chlorine from attacking the bulb components, and that the total amount of hydrogen and chlorine be sufficient to combine with carbon atoms escaping from the region surrounding the filament to reduce to a minimum deposit of uncombined carbon upon the inner wall of the bulb or upon other exposed surfaces. For example, the employment of benzene hexachloride produces an atmosphere comprising an atomic ratio of approximately one carbon atom to one chlorine atom to six hydrogen atoms. If the atmosphere is provided by a mixture of materials, such as a hydrocarbon and gaseous hydrogen chloride, a desirable atomic ratio is one carbon to three chlorine to five hydrogen. It is to be understood that these ratios may be varied widely, within the limits previously specified, without departing from the invention.

If this invention is to be used in an automobile headlamp, the reflector portion 20 of the lamp may be coated with any convenient reflecting surface, such as suitably protected aluminum.

Tests indicate that incandescent lamps constructed according to the features of this invention may be operated successfully for extended periods at temperatures of the order of 3500° K. Illuminating efficiencies may be obtained that are much higher than the efficiency of conventional bulbs, i.e., efficiencies of the order of two and a half times present-day efficiencies.

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 essentially tantalum carbide positioned within an atmosphere comprising, at operating temperatures, a halogen having an atomic weight of less than 100, hydrogen, and vaporized carbon.

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

5. A lamp according to claim 1, wherein the halogen comprises bromine.

6. A lamp according to claim 1, wherein the halogen comprises chlorine.

7. A lamp according to claim 6, wherein the chlorine is present in an amount in excess by volume of the amount of vaporized carbon present in the atmosphere, and wherein the atmosphere also comprises an excess by volume of hydrogen over chlorine, and an inert gas of low heat conductivity.

8. In an incandescent lamp, a filament comprising essentially tantalum carbide positioned within an atmosphere comprising, at operating temperatures, bromine, hydrogen, vaporized carbon, and an inert gas of low heat conductivity.

9. In an incandescent lamp, a filament comprising essentially tantalum carbide positioned within an atmosphere comprising, at operating temperatures, a halogen having an atomic weight of less than 100, hydrogen, vaporized carbon, and an inert gas selected from the class consisting of argon, xenon, and krypton.

10. In an incandescent lamp, a filament comprising essentially tantalum carbide positioned within an atmosphere comprising a source of hydrogen, chlorine, and vaporized carbon, said source providing an excess by volume of chlorine over the amount of vaporized carbon in the atmosphere and also providing an excess by volume of hydrogen over the amount of chlorine in the atmosphere.

11. A lamp according to claim 10, wherein the source comprises methylamine hydrochloride.

12. In an incandescent lamp, a filament comprising essentially tantalum carbide positioned within an atmosphere comprising, at operating temperatures, fluorine, hydrogen and vaporized carbon.

13. In an incandescent lamp, a filament comprising essentially tantalum carbide positioned within an atmosphere comprising, at operating temperatures, a halogen having an atomic weight of less than 100, hydrogen, and vaporized carbon, said atmosphere comprising said halogen, hydrogen, and vaporized carbon in a ratio of approximately 1 carbon atom to 3 halogen atoms to 5 hydrogen atoms.

14. A lamp, according to claim 13, wherein the halogen comprises chlorine.

15. In an incandescent lamp, a filament comprising tantalum carbide positioned within an atmosphere comprising at least one source of hydrogen, at least one source of a halogen having an atom weight of less than 100, and at least one source of carbon.

16. A lamp according to claim 15, wherein said atmosphere comprises hydrogen and a chlorinated hydrocarbon.

17. A lamp according to claim 16, wherein said chlorinated hydrocarbon comprises a chlorinated derivative of methane.

18. A lamp according to claim 17, wherein said chlorinated derivative of methane comprises carbon tetrachloride.

19. A lamp according to claim 15, wherein said atmosphere comprises a hydrocarbon and a gaseous hydrogen halide.

20. A lamp according to claim 19 wherein said hydrogen halide comprises hydrogen chloride gas.

21. A lamp according to claim 15, wherein said atmosphere comprises hydrogen, a halogen and a hydrocarbon.

22. A lamp according to claim 15 wherein said atmosphere comprises hydrogen and a brominated hydrocarbon.

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