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INCANDESCENT LAMP.

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This invention relates to incandescent lamp bulbs and has for its object the provision of a new and improved bulb which shall exhibit a high degree of efficiency in light production, coupled with long life and a desirable color of the emitted rays. More specifically stated the objects of the invention are to overcome certain of the disadvantages heretofore encountered in the use of tantalum as a filamentary material; while further objects and advantages of the invention will become apparent as the description proceeds.

The materials heretofore chiefly employed as incandescing bodies have been platinum, carbon, tungsten, and tantalum. Platinum was always hampered by its high cost and it has also always been adversely criticized because of its comparatively low specific resistance, although readily capable of being drawn into wire, and free from all difficulty of crystallization and entirely unaffected chemically by residual gases.

Carbon enjoyed the advantage of a very high degree of specific resistance but was unfortunate in possessing a negative temperature coefficient and of being impossible to secure in a pure form. Pure carbon cannot be fashioned into the shape of a filament. These devices, though nominally made of carbon always contain some proportion of hydrocarbon compounds which become volatilized before the lamp reaches a highly satisfactory operating temperature. Residual gases, however, have no specially injurious action if only the globe was reasonably well exhausted inasmuch as a small proportion of the comparatively large filament could combine with residual oxygen without seriously impairing the lamp.

Tantalum was tried for a considerable period but exhibited defects by reason of becoming extremely brittle especially under the influence of alternating current, and was subsequently practically abandoned in favor of tungsten, but tungsten, despite a very considerable amount of use, is defective in that its specific resistance is extremely low, lower than that of platinum, and while it has a rather high temperature coefficient which serves to reduce the electrical flow at the working temperature, still the comparatively low resistance of the lamp when cold gives rise to a sudden surge current when the same is turned on which often serves to rupture the filament; and in addition tungsten naturally occurs in crystalline form, is converted into a ductile wire only with great difficulty, and tends always to revert to crystalline form wherein it is brittle and short-lived.

I have discovered that an important source of difficulty with tantalum lies in its chemical affinity for residual gases, and that all the common gases even in small quantities, are extremely injurious thereto. With oxygen it combines to form an oxide which is soluble in the tantalum with substantial lowering of the melting point so that even a small amount of oxygen produces a sudden collapse of the filament; with nitrogen it combines at certain temperatures to form a nitride which is injurious in having an increased resistance and in being decidedly brittle. Nitrogen attacks the filament mainly at a point near where the tantalum wire is attached to the leading-in wire. The compound of tantalum with nitrogen is too unstable to withstand the working temperature of the lamp filament, but there is always a point adjacent the ends of the filament where the same is joined to the leading-in wires where the conduction of the heat away by these wires reduces the temperature of the filament to such extent as to permit chemical reaction with nitrogen with the result that the comparatively small amount of nitrogen remaining in the bulb is sufficient to injure this comparatively small portion of the filament. Owing to this small area of filament, and to the fact that nitrogen reaction is rather slow, it generally requires several hours burning before the filament breaks, but its breakage almost invariably occurs at this point.

I have discovered that if, after exhausting, the bulb be filled with substantially pure argon, the difficulties heretofore encountered with tantalum are almost entirely overcome. I preferably employ this at about atmospheric pressure although this may be varied somewhat in either direction, although it is not well to increase the pressure unduly when the lamp is cold, lest with the heating of the argon the increased pressure should burst the bulb. With this filling the embrittlement of the filament is entirely overcome, the life of the lamp greatly increased and its working temperature can be substantially elevated without injury to the filament or bulb.

I prefer to leave the argon in the bulb dur-

ing the use of the lamp as it permits operating the filament at higher temperatures and also apparently shields it from the action of the nitrogen, even though the same amount of nitrogen be present which in the absence of the argon was sufficient to destroy the filament. However, it is equally within my invention to exhaust this argon either in part or as completely as possible, thus reducing the amount of nitrogen present and having a vacuum lamp. So far as concerns this washing process the gases helium and neon and other of the chemically inactive rare gases of the atmosphere can equally well be employed since they serve to displace the nitorgen and are themselves inactive, but in case the gas is to be left in the globe the heavier argon is preferable since it exhibits a superior protective action owing to its higher atomic (molecular) weight.

I am aware that tungsten lamps have for a long time been filled with what is called "argon" but this filling gas as ordinarily used is not satisfactory for my purpose since it almost always contains nitrogen; and generally to an amount of around 25% whereas an amount of nitrogen in the bulb equal to one ten thousandth atmosphere is provably detrimental. Oxygen is equally injurious but more easily excluded as it comprises only ⅕ the atmosphere. The only gases which can safely be left inside the globe with a tantalum filament are those atmospheric constituents which enter into no chemical combinations and compose the zero group of the periodic table of elements. Indeed it appears that tantalum constitutes a more avid absorber of oxygen and nitrogen than any other substance I have hitherto been able to discover.

I do not confine myself to the use of filaments of pure tantalum but intend by the expression "consisting essentially of tantalum" to include such alloys or compositions which consist predominantly of elemental tantalum and which exhibit the herein described reactions of tantalum in the presence of the different gases mentioned.

Having thus described my invention what I claim is:

1. An incandescent lamp bulb having a filament consisting essentially of tantalum and an atmosphere consisting predominantly of argon and containing oxygen and nitrogen only in quantities too small to measure.

2. A incandescent lamp bulb having a filament consisting essentially of tantalum and an atmosphere consisting only of those atmospheric gases which are devoid of chemical combining power.

3. An incandescent lamp bulb having a filament consisting essentially of tantalum and a highly tenuous atmosphere which is essentially devoid of those atmospheric gases which possess chemical combining power.

In testimony whereof I hereunto affix my signature.

OSCAR V. MAURER.