Nov. 22, 1960 K. S. G. PERTWEE 2,961,568

FILAMENT JOINT FOR INCANDESCENT LAMPS

Filed Nov. 14, 1957

Fig. 1.

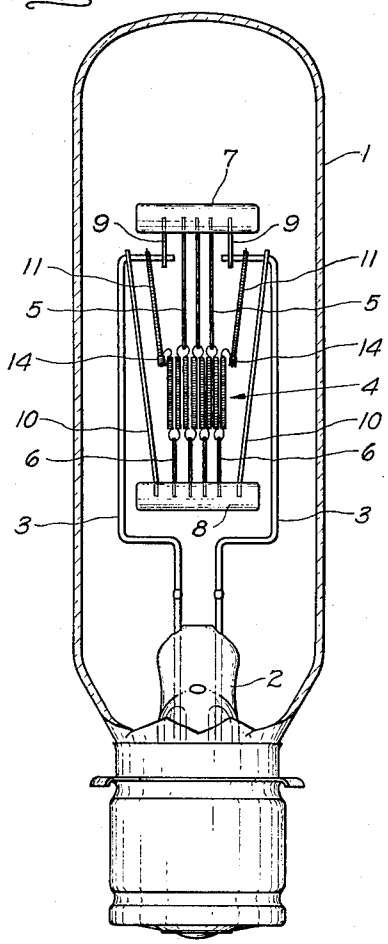
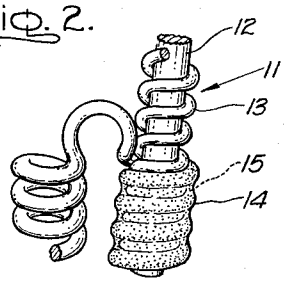


Fig. 2.



Inventor:
Kenneth S. G. Pertwee,
by Otto Richter
His Attorney.

United States Patent Office 2,961,568
Patented Nov. 22, 1960

2,961,568

FILAMENT JOINT FOR INCANDESCENT LAMPS

Kenneth S. G. Pertwee, Cleveland, Ohio, assignor to General Electric Company, a corporation of New York

Filed Nov. 14, 1957, Ser. No. 696,509

6 Claims. (Cl. 313—271)

My invention relates to electric incandescent lamps comprising a sealed bulb or envelope containing a tungsten filament connected to current supply conductors through which current is conveyed from terminals at the exterior of the bulb. More particularly my invention relates to the joint or connection between the ends of the filament and the current supply conductors.

The filaments of incandescent lamps are generally connected to the current supply or lead-in conductors by a mechanical joint as opposed to a welded joint which tends to cause embrittlement and weakening of the tungsten filament adjacent to the joint, with consequent breakage. In certain types of lamps a satisfactory joint is made simply by securely clamping a hook in the end of the current supply conductor about the end of the filament. However, in other lamp types, particularly higher wattage lamps, such a joint is not feasible because the conductor is necessarily of larger size and is usually also made from more refractory and harder metal. The art has therefore resorted to joints of rather complicated structure in order to secure a satisfactory mechanical and electrical connection. However, in certain cases the frictional connection is unsatisfactory since it permits the filament to move and also permits a certain amount of arcing and local overheating at the joint. Such arcing produces a noise which, in the case of projection lamps used in movie or television studios, is picked up by nearby microphones.

It is therefore an object of the present invention to provide an improved filament joint wherein the filament is firmly bonded to the current supply conductor to provide a rigid connection and good electrical conduction without welding and without the introduction of materials deleterious to the operation of the lamp.

In accordance with one aspect of my invention, the filament is joined at its ends to current supply conductors of refractory metal such as molybdenum, tungsten, tantalum or columbium (niobium) and the joint is firmly bonded by applying thereto an intimate mixture of fine tungsten powder and fine platinum powder preferably made into a paste with a suitable temporary binder which is dispersed by decomposition or volatilization upon heating. The joint is then heated in a non-oxidizing atmosphere at a temperature above the melting point of platinum (1763° C.) but below the melting point of the filament or the current supply conductor. The platinum particles are thereby melted and joined firmly to all adjacent surfaces of the tungsten filament and the refractory metal current supply conductor and form an alloy therewith. At the same time, the mixture becomes consolidated and, by alloying, the meeting point of the mixture is raised considerably so that it does not melt during subsequent operation of the filament at incandescence. For this reason, it is impracticable to employ a preformed alloy of tungsten and platinum; its melting point would be so high as to make it impractical to melt the alloy without damage to the filament or current supply conductor. Also, a bond employing no platinum and consisting of a suspension of molybdenum or tantalum

powder in a suitable binder is not entirely satisfactory since it tends to flake off and contaminate the tungsten filament.

I have found that good results are obtained with a mixture of tungsten and about 5–15% platinum by weight, preferably about 10% platinum and 90% tungsten. A lesser amount of platinum does not give a sufficiently strong bond because the mixture flakes off. Amounts of platinum in excess of 15% are not necessary and would therefore unduly increase the expense and would also reduce the melting point of the alloy. Although there is a firm consolidation of the mixture and alloying of the platinum with adjacent surfaces of the filament and current supply conductor as well as with tungsten particles in the mixture, the resultant reaction product is probably not a homogeneous alloy. On the other hand, there is apparently no free metallic tungsten powder in the product although some of the tungsten particles may have only a layer of platinum alloyed at the surface thereof. At any rate, the resultant bond assumes a shiny metallic surface appearance and forms a firm and rigid connection of good electrical conductivity.

Good results may be obtained with platinum powder of about 150 mesh or finer and tungsten powder of about 200 mesh or finer. The binder may be a cellulosic material such as a solution of ethyl cellulose or nitrocellulose. Satisfactory results have been obtained with a mixture of 100 grams of powder consisting of 90 grams tungsten powder and 10 grams platinum powder thoroughly milled to form an intimate mixture to which is added 20 cc. of a solution of ethyl cellulose in butyl acetate having a viscosity of about 50 to 60 seconds in a No. 7 du Pont cup, or approximately 50 centipoises. The viscosity may be adjusted by addition of solvent to provide a fairly thin paste of a viscosity suitable for application by means of a brush.

The accompanying drawing illustrates an embodiment of the invention, by way of example, in an otherwise conventional high wattage projection lamp. In the drawing, Fig. 1 is an elevation of the lamp and Fig. 2 is a fragmentary view of the filament joint on an enlarged scale.

Referring to the drawing, the lamp illustrated therein comprises a sealed glass bulb or envelope **1** containing an inert gas filling and having a reentrant stem **2** through which is sealed a pair of current supply or lead-in conductors **3**. The filament **4** may be of the monoplane or biplane types comprising a plurality of coiled sections arranged in parallel relationship in or adjacent to a single plane which also includes the conductors **3**. The coiled sections of the filament are serially connected by loops or bight portions by means of which the filament is supported at the top and bottom by respective groups of support wires **5** and **6** which are anchored in respective top and bottom glass bridges **7** and **8** which are, in turn, supported from the conductors **3** by pairs of support wires **9** and **10**.

The ends of the filament **4** are electrically connected to the conductors **3**, in this case by means of auxiliary current supply conductors or spuds **11**. The spuds illustrated herein are of the type disclosed in Patent 2,449,679, Van Horn, and each consists of a length of rigid wire **12** overwound with a finer wire **13** at a pitch corresponding to that of a short coiled leg portion **14** at the end of the filament. The wires **12** and **13** are preferably made of molybdenum although wires of tungsten, tantalum or columbium may also be employed. One end of the composite spud **11** is screwed into the coiled leg **14** and the other leg is connected, preferably by welding, to a conductor **3**. While such joints have been used successfully in many applications, yet they have been found not to be wholly satisfactory at times since they

have allowed the filament to move and permitted a certain amount of arcing and local overheating.

In accordance with the present invention, the joint is materially improved and looseness is eliminated by application of the bonding material described above and indicated at **15** (Fig. 2). The paste composed of tungsten and platinum powders and binder is applied to the joint in any suitable manner. For example, a rather thin paste is applied by brushing over the joint; a mere touch of the brush at opposite sides of the joint is sufficient, preferably at the end of the spud **11** where it is screwed into the coiled leg **14**. The joint is then heated in a non-oxidizing environment, preferably a reducing atmosphere, to a temperature above the melting point of platinum, preferably to about 1850° C.

The heating of the joint may be carried out in any suitable manner. For example, the heating may be accomplished during the conventional flashing treatment in a hydrogen bottle wherein the filament, mounted in place on the lead-in conductors **3** and before sealing of the bulb **1** to the stem **2**, is subjected to a cycle of applications of increased voltage while disposed in a bottle containing an atmosphere of hydrogen. During the flashing cycle the binder is dispersed and the platinum particles in the bonding mixture **15** melt and bond firmly to all adjacent tungsten and molybdenum surfaces to securely hold the spud **11** and filament leg **14** together. The mixture becomes consolidated and the platinum alloys with portions of the filament leg **14**, spud wires **12** and **13** and tungsten particles in the mixture. Alternatively, the sub-assembly of filament **4** and spuds **11** may be set in a jig and placed in a hydrogen furnace and fired at a temperature and for a time sufficient to melt the platinum, for instance for 3 minutes at about 1850° C.

The resulting bond firmly holds together the filament end leg **14** and the current supply conductor or spud **11** throughout the life of the lamp without the introduction of any contaminants which might adversely affect operation of the lamp. In fact, tests have shown an actual improvement in maintenance of light output during life, as compared with similar standard lamps in which the bonding material was not employed, amounting to about 3% more light after burning for 50% of normal life. This is probably due to a reduction in blackening by the elimination of arcing at the filament joint.

It will be understood that the structure of the filament connection or joint may be widely varied and satisfactorily bonded by the platinum-tungsten mixture. For example, good results have been obtained when the overwind wire **13** was eliminated, the spud then being simply a wire **12** of diameter suitable to fit tightly in the coil leg **14** and firmly bonded thereto by the fusion of the platinum-tungsten mixture. Moreover, the use of auxiliary spuds may be entirely dispensed with and the ends of the filament coiled around the conductors **3** and bonded thereto by the platinum-tungsten mixture when those conductors are made of a refractory metal such as molybdenum.

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

1. In an electric incandescent lamp, the combination of a current supply conductor of metal of the class consisting of molybdenum, tungsten, tantalum and columbium, a tungsten filament joined at one end to said conductor and bonded thereto by the heat reaction product of an intimate mixture of finely divided particles of tungsten and 5 to 15 percent by weight platinum.

2. In an electric incandescent lamp, the combination of a current supply conductor of metal of the class consisting of molybdenum, tungsten, tantalum and columbium, a tungsten filament joined at one end to said conductor and bonded thereto by the heat reaction product of an intimate mixture of finely divided particles of tungsten and about 10% by weight platinum.

3. In an electric incandescent lamp, the combination of a current supply conductor of molybdenum, a tungsten filament joined at one end to said conductor and bonded thereto by the heat reaction product of an intimate mixture of finely divided particles of tungsten and 5 to 15 percent by weight platinum.

4. The method of bonding a joint between an incandescible tungsten filament and a current supply conductor of metal of the class consisting of molybdenum, tungsten, tantalum and columbium which comprises applying to the joint a paste composed of an intimate mixture of finely divided particles of tungsten and platinum in a heat-decomposable binder and in proportions by weight of between 5 and 15 percent platinum and 95 to 85 percent tungsten, and heating the joint in a non-oxidizing environment to a temperature above the melting point of platinum but below the melting points of the said conductor and filament and for a time sufficient to decompose the binder, melt the platinum particles and sinter together the tungsten particles whereby the platinum alloys with the adjoining surfaces of the conductor, filament and tungsten particles to form a firm bond.

5. The method of bonding a joint between an incandescible tungsten filament and a current supply conductor of metal of the class consisting of molybdenum, tungsten, tantalum and columbium which comprises applying to the joint a paste composed of an intimate mixture of finely divided particles of tungsten and platinum in a heat-decomposable binder and in proportions by weight of about 90% tungsten and 10% platinum, and heating the joint in a non-oxidizing environment to a temperature above the melting point of platinum but below the melting points of the said conductor and filament and for a time sufficient to decompose the binder, melt the platinum particles and sinter together the tungsten particles whereby the platinum alloys with the adjoining surfaces of the conductor, filament and tungsten particles to form a firm bond.

6. The method of bonding a joint between the coiled end portion of an incandescible tungsten filament and a portion of a molybdenum current supply conductor fitted closely in the said coiled end portion of the filament, which comprises applying to the joint a thin paste consisting of an intimate mixture of finely divided particles of tungsten and platinum in a heat-decomposable cellulosic binder and in proportions by weight of 5–15% platinum and 95–85% tungsten, and heating the joint in a non-oxidizing atmosphere to a temperature of about 1850° C. for a time sufficient to decompose the binder, melt the platinum particles and sinter together the tungsten particles whereby the platinum alloys with the adjoining surfaces of the conductor, filament and tungsten particles to form a firm bond.

References Cited in the file of this patent

UNITED STATES PATENTS

2,039,772	Braselton	May 5, 1936
2,258,158	Lowry	Oct. 2, 1941
2,300,959	Pironi	Nov. 3, 1942
2,341,716	Herdman	Feb. 15, 1944
2,434,478	Allen	Jan. 13, 1948
2,449,679	Van Horn	Sept. 21, 1948
2,462,837	Braunsdorff	Mar. 1, 1949
2,464,591	Larsen	Mar. 15, 1949
2,844,868	Cline	July 29, 1958