June 15, 1965 W. L. BRUNDIGE 3,189,778

LAMP FILAMENT CONNECTION

Filed Jan. 29, 1962

FIG. 1.

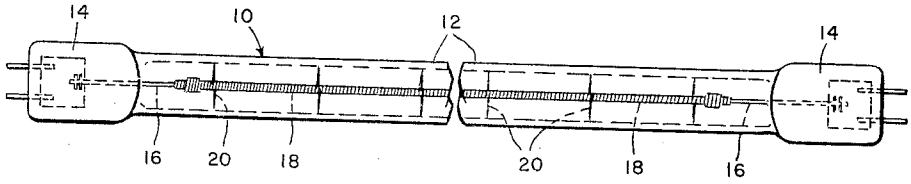


FIG. 2.

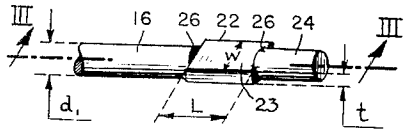


FIG. 3.

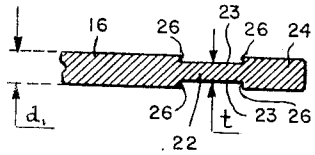


FIG. 4.

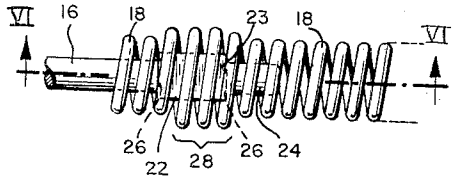


FIG. 5.

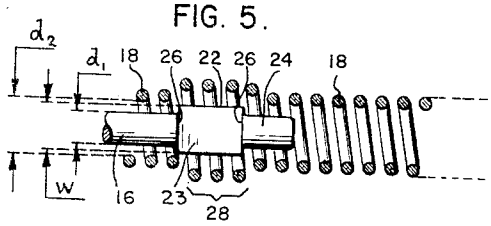


FIG. 6.

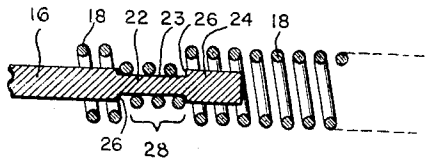


FIG. 7.

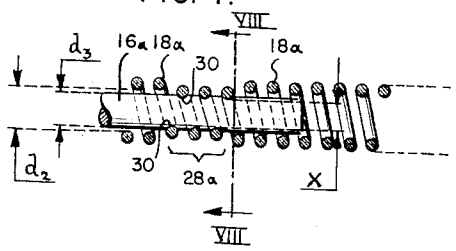
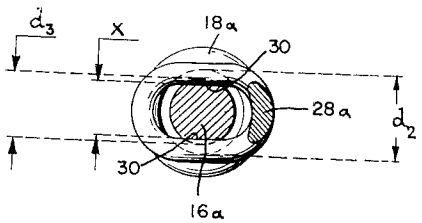


FIG. 8.



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LAMP FILAMENT CONNECTION

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3 Claims. (Cl. 313—331)

This invention relates to electrical devices and, more particularly, to an improved mechanical and electrical connection between the filament and lead-in conductor or supporting member of an incandescent electric lamp.

In the manufacture of certain types of electric lamps, such as high-wattage tubular heat lamps having coiled filaments of relatively heavy wire for example, the size and rigidity of the lead-in conductor makes it difficult to connect it to the filament. One frequently used method of joining these members together is to enlarge the end of the conductor and force it into the coil until it becomes caught behind the end turns of the filament. A juncture of this type wherein the end of the conductor is flattened to provide a spade-like tip that effects a force-fit with the filament coil is disclosed in U.S. Patent No. 2,830,217, issued April 8, 1958.

Another and older method of effecting such junctures is to form threads on the end of the conductor either by a cutting operation or by winding a wire tightly around the conductor at the proper pitch. The threaded end of the conductor is then screwed into the end of the coiled filament thus threadably coupling the members together. Threaded conductors and connections of this character are illustrated and described in U.S. Patent No. 2,449,679, issued September 21, 1948.

The lead-to-filament connection has also been effected in some cases by welding the members together.

It is accordingly the general object of this invention to provide an improved filament connection that does not require a critical dimensional fit of the members and thus eliminates this problem and overcomes other disadvantages of the prior art structures.

A more specific object is the provision of a filament juncture that is simple, inexpensive, and reliably locks the members in opposite electrical engagement without any additional parts or critical interfitting of the members.

The foregoing objects, and others which will become obvious as the description proceeds, are achieved in accordance with this invention by providing a recess and a pair of abrupt transversely-extending shoulders at a preselected point along the conductor, inserting this recessed portion into the coiled filament, and then permanently deforming and collapsing an intermediate portion of the filament into the recess. The partly flattened filament portion is retained within the recess by the shoulders thereby securely locking the members together in electrical engagement and preventing the filament from slipping along the conductor in either direction.

The recess and retaining shoulders can be formed at the same time that the filament turns are collapsed by simultaneously applying sufficient heat and pressure to the filament turns and the underlying portion of the inserted conductor, preferably in the presence of an inert atmosphere.

A better understanding of the invention will be obtained by referring to the accompanying drawing wherein:

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FIG. 1 is an elevational view of one form of electric lamp embodying my invention, a central portion of the lamp being omitted for convenience of illustration;

FIG. 2 is an enlarged perspective view of the connecting end of a lead-in conductor in accordance with one embodiment of the invention;

FIG. 3 is a cross-sectional view of the conductor taken along the line III—III of FIG. 2, in the direction of the arrows;

FIG. 4 is a plan view of the conductor shown in FIGS. 2 and 3 connected with one end of the coiled filament in accordance with this invention;

FIG. 5 is a view corresponding to that shown in FIG. 4 but with a portion of the filament omitted for illustrative purposes;

FIG. 6 is a cross-sectional view of the connection along the line VI—VI of FIG. 4;

FIG. 7 is an elevational view of another type of juncture according to the invention; and

FIG. 8 is an enlarged cross-sectional view along the line VIII—VIII of FIG. 7, in the direction of the arrows.

While the improved filament connection of this invention can be employed in various types of lamps and electrical devices, it is especially suited for use in conjunction with high-wattage tubular infrared-generating lamps and has accordingly been so illustrated and will be so described.

With specific reference to the drawing, in FIG. 1 there is illustrated a tubular heat lamp 10 comprising a quartz envelope 12 of relatively small diameter that is closed at each end by a press seal 14. Sealed within the envelope is a coiled filament 18 of helical configuration wound from a suitable refractory metal wire, such as tungsten for example. The filament extends longitudinally of the envelope and is centrally mounted therein by means of lead-in conductors 16 of molybdenum or the like embedded in each of the press seals and by a plurality of spaced supporting discs 20 of tantalum, or other suitable refractory material, that are inserted between adjacent turns of and are anchored to the filament at preselected points along its length. The lead-in conductors 16 are fastened to the usual ribbon-and-terminal assemblies embedded in each of the press seals to facilitate connecting the lamp to a voltage source. In order to prevent the filament 18 from sagging during use, the lead-in conductors 16 are so spaced during the sealing-in operation that the filament is tensioned slightly and kept taut. The envelope contains the usual filling of a suitable inert gas such as argon or the like.

A detailed description of a lamp of the foregoing type is given in U.S. Patent No. 2,864,025 dated December 9, 1958.

In accordance with one form of the present invention a preselected portion of each of the lead-in conductors 16 is deformed to provide a flat 22 proximate to, but spaced inwardly from, one end of the conductor, as shown in FIGS. 2 and 3. The reduction in cross-section of this portion is such that in the case of a conductor wire 16 of molybdenum or the like having a substantially uniform diameter d_1, a flat 22 of predetermined length L, width W, and thickness t is provided, as is illustrated. Preferably, the reduction in cross section of the wire is such that the thickness t of the flat 22 is no greater than about ⅘ of the wire diameter d_1 so as to form pronounced recesses 23 (see FIG. 3) on opposite sides of the conductor, which recesses are terminated at each end by transversely

extending shoulders 26 that are well defined and rise abruptly from the flat 22. The rounded contour of the conductor is, accordingly, abruptly altered by the flat 22 whereas the extreme end portion 24 of the conductor retains its original shape, as shown in FIGS. 2 to 6.

As shown in FIG. 5, the width W of the flat 22 is made slightly smaller than the inner diameter d_2 of the coiled filament 18 so that the flattened portion of the conductor 16 can very readily be inserted into the end section of the filament. Moreover, the length L of the flat is such that it extends for a plurality of turns of the filament 18, such as three turns thereof as in the case illustrated in FIGS. 4 to 6.

To effect the juncture according to the embodiment shown in FIGS. 4 to 6, the flattened portion of the conductor is first inserted into the coiled filament and positioned so that the flat 22 is located beyond the end turns and within an intermediate portion 28 of the filament. The filament turns comprising the overlying intermediate portion 28 are then permanently deformed and partly collapsed by simultaneously heating this portion of the filament and compressing it in a direction substantially normal to the surface of the flat. In order to avoid deleteriously oxidizing the filament or conductor, heating and bending of the filament turns is preferably performed in an inert atmosphere such as nitrogen.

The aforesaid heating and compressing operation partly collapses the intermediate portion 28 of the filament 18 into the recesses 23 and forces the bent turns into intimate engagement with the flat 22, as illustrated in FIGS. 4 to 6. Moreover, as shown most particularly in FIG. 6, the outermost turns of the collapsed intermediate portion 28 of the filament are caught and seated behind the transversely extending shoulders 26 located at each end of the flat thus securely locking the collapsed turns within the recesses and coupling the filament and conductor wire in positive electrical and mechanical engagement.

Heating and bending of the filament turns that comprise the intermediate portion 28 can be conveniently accomplished by means of a pair of suitably shaped jaws (not shown) having electrically heated work faces.

As a specific example of the actual dimensions involved, in the case of a 500 watt infrared heat lamp having a lead-in wire 0.025" in diameter and a filament coil with an inside diameter of about 0.040" wound from tungsten wire .0098" in diameter, satisfactory connections have been obtained by employing a flat approximately 1/16" long, 0.035" wide and about 0.015" thick.

It should be noted that the intermediate portion of the filament to be collapsed need only be heated sufficiently to render it easily deformable. Thus, temperatures in the order of approximately 200° C. in the case of a tungsten filament will suffice.

As shown in the alternative embodiment illustrated in FIGS. 7 and 8, the desired mechanical and electrical juncture can also be achieved in accordance with this invention by utilizing a straight or unmodified piece of conductor wire 16*a*, that is, one which is not provided with a flat or deformed portion near one end. The conductor wire in this case is fabricated from a relatively soft metal such as annealed nickel, copper or the like and has a diameter d_3 that is slightly less than the inside diameter d_2 of the filament 18*a*, as indicated in FIG. 7.

After the end of the conductor 16*a* has been inserted into the proper position within an intermediate portion 28*a* of the filament this portion and the underlying segment of the conductor are simultaneously heated and compressed along a line normal to the wire axis until the partly collapsed filament turns are at least partly embedded in the conductor at a plurality of points 30 located on opposite sides of the conductor and inward from its proximate end, as shown in FIG. 7. The applied heat and pressure are such that the distance x between

the collapsed turns, measured in the same direction as that in which the pressure was applied, is considerably less than the diameter d_3 of the wire, as indicated in FIGS. 7 and 8. A plurality of transverse grooves are accordingly impressed into the conductor by the collapsed filament turns.

Thus, in this embodiment the deformation of the conductor and partial collapse of the overlying intermediate portion of the filament are both accomplished by means of a single operation. It will be obvious from FIG. 7 that sufficient heat and pressure are applied to form the same combination of pronounced recesses and abrupt retaining shoulders as in the case of the first embodiment shown in FIGS. 1 to 6.

After the filament turns have been collapsed and interlocked with the conductor, the application of heat and pressure is discontinued. Preferably, the heating is discontinued first and sufficient pressure is maintained on the collapsed turns until the members have cooled somewhat so as to prevent any spring-back and resultant looseness of fit from occurring during the cooling-down stage.

It will be obvious, of course, that the aforementioned grooves can be formed in the surface of the conductor, as by stamping, to provide a preformed conductor as in the case of the embodiment shown in FIGS. 2 to 6.

It will be apparent from the foregoing that the objects of the invention have been achieved by providing an improved electrical and mechanical junction between a filament and lead-in conductor or support which connection is simple and inexpensive to fabricate.

While several embodiments of the improved connection have been described in detail, these are given merely by way of example and various structural and procedural modifications can accordingly be made without departing from the spirit and scope of this invention. For example, the filament does not have to be coiled throughout its length but may be provided with coiled end sections that are interlocked with the lead-in member in the manner described.

I claim as my invention:

1. In an electric incandescent lamp, the combination of a refractory wire filament having a coiled end section, and a lead-in conductor that is smaller in diameter than the inside diameter of said coiled end section and has a flat that is located proximate but inward from one end of said conductor and fits freely within said coiled end section, the rounded contour of said lead-in conductor being abruptly altered by said flat thereby providing an elongated recess that is terminated at each end by a transversely-extending sharply-defined shoulder, said flat being located within an intermediate portion of said coiled end section and of sufficient length to accommodate more than one turn of said coiled end section, the turns of said coiled end section overlying said flat being collapsed into said recess and seated between said shoulders thereby locking said conductor in mechanical and positive electrical engagement with said filament.

2. In combination with a filament of refractory metal wire having a coiled end section comprising a plurality of spaced turns, a conductor that is freely insertable into said coil end section and has an elongated recess which is located proximate to but inward from one end of said conductor and is defined by a pair of abrupt transversely-extending shoulders, said conductor being inserted into said coiled end section a distance such that the recessed portion of said conductor is located within an intermediate portion of said coiled end section and the proximate end portion of said conductor projects therebeyond toward the filament proper, a plurality of the turns comprising the overlying intermediate portion of said coiled end section being permanently deformed and collapsed into said recess and seated therein between and in interlocking relationship with said shoulders, thereby mechanical-

ly coupling siad conductor and filament in positive electrical engagement.

3. The combination of an interlocked filament and a conductor as set forth in claim 2 wherein said conductor has a second elongated recess that is located on its opposite face and, together with the other recess, defines a flat having a width less than the inside diameter of said coiled end section and a thickness no greater than about 4/5 that of said conductor.

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