

[54] **METHOD OF MANUFACTURING AN ELECTRIC LAMP FILAMENT HAVING A COILED-COIL BODY PORTION WITH ORIENTED OFF-SET LEGS**

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**Related U.S. Application Data**

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[58] Field of Search ....29/25.1, 25.11, 25.14, 25.15, 29/25.17, 25.18, 25.13; 140/71.5

[56]

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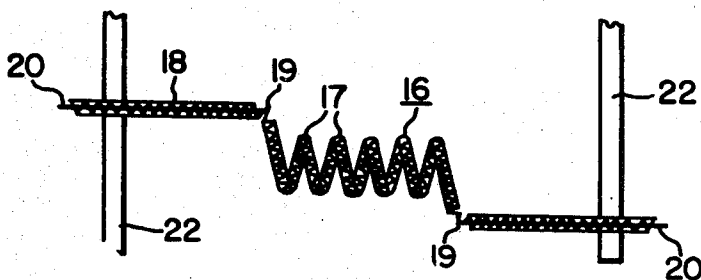
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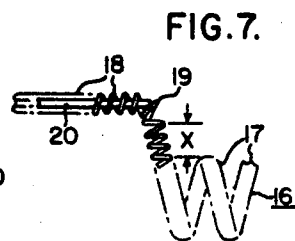
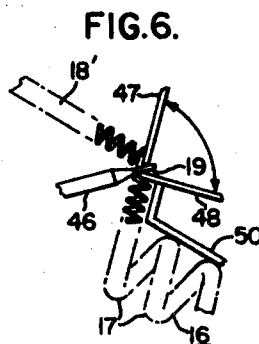
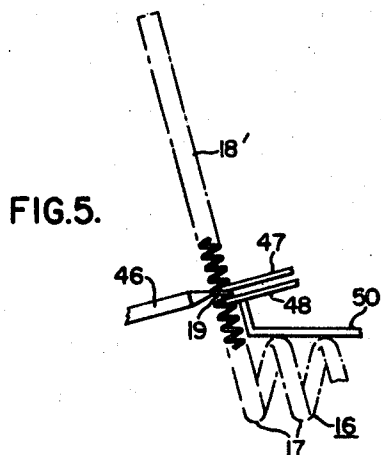
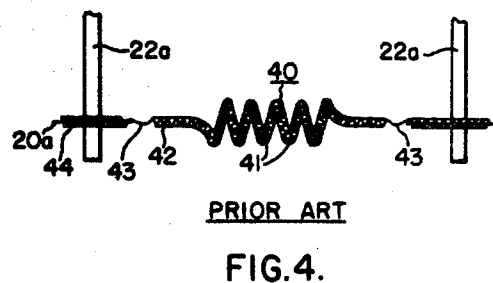
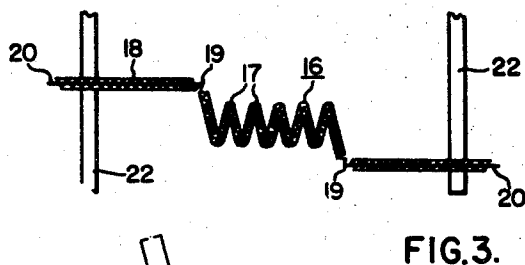
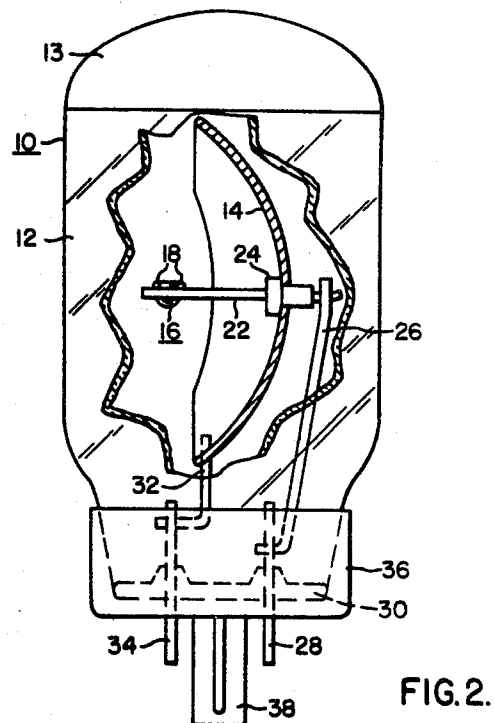
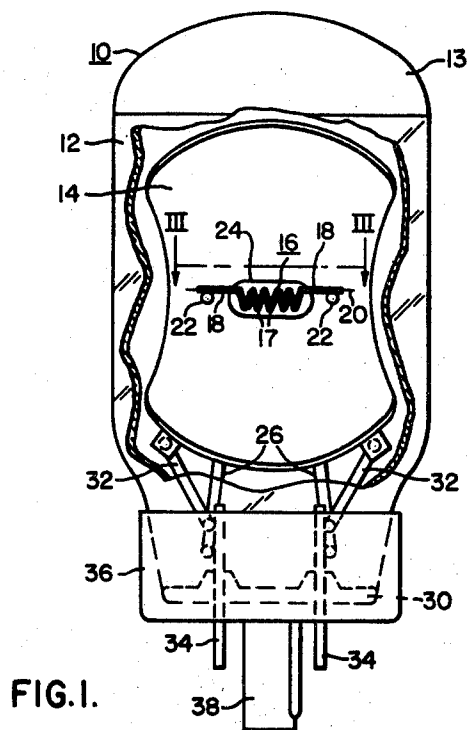
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**ABSTRACT**

A coiled-coil filament of refractory metal wire having longitudinally depending legs at each end that are joined to the coil barrel by open primary turns which are permanently bent through predetermined angles. The filament is initially wound as a continuous coil and, after the second coiling operation has been completed and the primary and secondary mandrels have been removed, selected primary turns in each of the then transversely extending legs are bent around an abutting stationary anvil to reposition the legs in the desired off-set relationship with the coil barrel.

**3 Claims, 7 Drawing Figures**





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# METHOD OF MANUFACTURING AN ELECTRIC LAMP FILAMENT HAVING A COILED-COIL BODY PORTION WITH ORIENTED OFF-SET LEGS

## CROSS-REFERENCE TO RELATED APPLICATION

This application is a division of application Ser. No. 648,430 filed June 23, 1967 (now U.S. Pat. No. 3,588,579).

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates to electric lamps and has particular reference to an improved method for manufacturing coiled-coil filaments for incandescent projection lamps and other light sources.

### 2. Description of the Prior Art

Certain types of projection lamps now being marketed require low voltage so-called "CC6" filaments. These filaments comprise a refractory wire (viz., tungsten) helix having a coiled-coil body portion or barrel with longitudinally extending legs at each end. The legs are attached to the lead-in conductors of the mount structure and hold the filament in horizontal position within the lamp envelope in front of an internal reflector. Heretofore it has been the standard practice to wind a primary turn in the middle of each of the legs at a much greater pitch to provide an open turn or "break". The resulting temperature of the outer leg sections and the welded junctures thereof with the lead wires without an excessive heat drain on the end turns of the coil barrel. These open turns or breaks also served as a reference point for positively locating the ends of the tungsten or molybdenum inserts employed to short out and cool the leg ends. Such positive location of the leg inserts is required to properly control the rating of the filament. A projection lamp having a filament with these features is disclosed in U.S. Pat. No. 3,383,539 issued May 14, 1968 to R. F. Scoledge et al.

However, since the aforesaid open turns in the primary winding are formed before the second coiling operation and must be accurately positioned in the legs of the coil after the secondary coiling operation has been completed, the latter operation had to be performed on manually operated equipment. Such special primary coiling and hand-wound secondary coiling are not only critical time-consuming operations but increase the manufacturing cost of the filaments and make it difficult to control the filament rating.

## SUMMARY OF THE INVENTION

It is accordingly the general object of the present invention to provide a method for manufacturing such coiled-coil filaments efficiently on a mass production basis using automatic primary and secondary coiling machines of conventional design.

The foregoing objective and other advantages are achieved in accordance with the present invention by forming embryonic coiled-coil filaments on continuous primary-winding and automatic retractable-mandrel secondary-winding machines known and used in the industry. The resulting coils are then placed in a jig and a preselected turn in each of the transversely extending legs is bent by suitable tools, such as a pair of bending knives and an anvil, through a predetermined angle to form the desired open turn or break in the legs and reposition the legs in longitudinally extending and precise off-set relationship with the coil barrel.

## BRIEF DESCRIPTION OF THE DRAWING

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

FIGS. 1 and 2 are front and side elevational views, respectively, of an incandescent projection lamp containing the improved coiled-coil filament of the present invention, portions of the envelope being removed to show the construction details of the filament and mount assembly;

FIG. 3 is an enlarged plan view of the filament and associated lead-in conductor portions of the mount along the line III—III of FIG. 1;

FIG. 4 is a similar view of a prior art filament and mount assembly; and

FIGS. 5 to 7 are enlarged elevational views of one end of the filament showing various phases in the leg-bending operation.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1 and 2 there is shown a 150 watt 21 volt T12 projection lamp 10 having a tubular vitreous envelope 12 that has a domed top coated with a layer 13 of suitable opaque material and which contains an elliptical reflector 14 and the improved coiled-coil filament 16 of the present invention. The filament 16 is supported in a substantially horizontal position at the focal point of the reflector 14 by a pair of rigid leading conductors 22 that extend through a ceramic insulator 24 fitted into an opening in the reflector 14. As shown more particularly in FIG. 2, these conductors 22 are spot welded to up-standing support wires 26 which are, in turn, fastened to a pair of rigid pins 28 hermetically sealed through a vitreous disc or wafer 30 that is fused to and closes the mouth of the envelope 12. A pair of auxiliary support wires 32 fastened to tabs provided at the lower edge of the reflector 14 and to a pair of dummy pins 34 hermetically sealed through the wafer 30 securely anchor the reflector in place. A cylindrical metal base 36 having a keyed center post 38 is cemented to the sealed end of the envelope 12 in accordance with standard lamp-making practice.

As will be noted in FIGS. 1 and 2, the filament 16 has a coiled-coil body portion or barrel that consists of a plurality of secondary turns 17 and is terminated at each end by singly coiled straight leg portions 18 that extend in the direction of the axis of the coil barrel and are attached to the conductors 22. As viewed in FIGS. 1 and 2, the filament legs 18 are both disposed in a plane that is substantially tangent to the uppermost sides of the secondary turns 17 or top surface of the coil barrel. When viewed in a direction normal to this plane, as depicted in FIG. 3, the aforesaid legs 18 are disposed in two separate plans that are parallel to and spaced predetermined distances from the proximate sides of the coil barrel. The filament 16 is thus held in predetermined position relative to the reflector 14 by the offset legs 18 and lead-in conductors 22 to which they are welded.

As shown most clearly in FIG. 3, the legs 18 are joined to the respective end (or terminal) secondary turns 17 by bent opened primary turns 19 that are located predetermined and equal distances beyond the proximate sides of the coiled-coil. An insert 20 of molybdenum or tungsten is inserted into each of the legs 18 in accordance with standard practice to facilitate welding the legs to the conductors 22 and to cool them when the filament 16 is energized. These inserts are seated against the bent primary turns 19 which thus serve as stops. As will also be noted, the primary turns that define the offset leg portions 18 are of the same diameter and have the same spacing as the primary turns in the coiled-coil body portion.

In contrast to the sharp angularly offset coil legs 18 provided by the transversely bent primary turns 19 of the improved filament 16, a prior art filament 40 of the same size and rating (shown in FIG. 4) has a coiled-coil body portion that consists of the same number of secondary turns 41 but is terminated by longitudinally depending inner leg sections 42 that are joined to the coil barrel by leg segments that are gently tapered or bent in a smooth curve. Moreover, the inner leg sections 42 are joined by axially extending open primary turns 43 to straight outer leg sections 44. The inserts 20a are located within these outer leg sections 44, and the latter are welded to the leads 22a.

# FILAMENT MANUFACTURE AND LEG-BENDING OPERATION

The coiled-coil filament 16 is manufactured in accordance with the present invention by winding a fine tungsten wire around a mandrel of dissimilar metal, such as molybdenum, on a conventional automatic primary-coiling machine to provide a composite wire having a continuous winding of uniformly spaced primary turns. This composite wire is then automatically wound about a second and larger mandrel on a conventional secondary-winding machine which has a mechanically retractable mandrel. The transversely extending legs of the resulting helix are automatically cut on the secondary machine so that, after the primary mandrel has been chemically dissolved in the usual manner, a leg 18' of predetermined length is left at each end of the coil 16, as shown in FIG. 5.

The partly fabricated coils 16 are then placed in a jig which has a pointed stationary anvil 46 that engages the outer surface of a preselected primary turn 19. The jig includes a pair of bending knives 47 and 48 which, when actuated by a suitable known mechanism (not shown), are inserted between the primary turn 19 and the adjacent primary turns from the opposite side of the leg 18'. In the embodiment here shown, a positioning bar 50 attached to the knife 48 is seated against the proximate side of the coil barrel. Thus, a line tangent to the secondary turns 17 is used as a reference surface for gauging purposes and insures that same primary turn 19 (the third turn beyond the barrel in the case here illustrated) will be engaged by the anvil 46 and knives 47, 48. This, in turn, controls the total number of primary turns in the coil barrel and insures that the number of such turns in each filament is the same, within a tolerance of plus or minus one primary turn. The filaments are thus reproducible and have the same rating.

When the anvil 46 and knives 47 and 48 are properly positioned, the knives are again actuated and swung in opposite directions through an angle of approximately 90°, as shown in FIG. 6, around the stationary pivot point established by the anvil 46. The primary turn 19 is thus bent from its "as-wound" configuration through an angle such that the portion of the embryonic leg 18' beyond the bent turn is disposed in the desired parallel relationship with the axis of the coiled-coil. The bending operation is repeated at the other end of the coil and the coil is removed from the jig. As is shown in FIG. 7, the finished coils 16 thus have a sharply offset leg 18 at each end that is joined to the coil barrel by a transversely bent and opened turn 19 which is spaced a predetermined and constant distance  $x$  beyond the barrel. The inserts 20 are then placed in the legs 18 and the filament 16 is ready for mounting.

As will be apparent from the foregoing, the object of the invention has been achieved in that an efficient method for making coiled-coil lamp filaments on a mass-production basis

making coiled-coil lamp filaments on a mass-production basis has been provided. Experience has shown that the elimination of the discontinuous primary winding and the manual secondary coiling operations effected by the present invention has reduced the manufacturing cost of 21 volt CC6 filaments by approximately 65 percent without any adverse effect on the coil quality.

While a preferred embodiment has been disclosed, it is to be understood that various modifications can be made without departing from the spirit and scope of the invention.

I claim as my invention:

1. The method of manufacturing an electric lamp filament having a coiled-coil body portion and angularly off-set legs, which method comprises;

winding a refractory metal wire around a first mandrel of dissimilar metal to form a composite wire that includes a continuous primary winding of wire, winding a said composite wire around a second and larger mandrel and forming an elongated helix having a protruding leg portion of predetermined length at each end that extends transversely of the longitudinal axis of said helix, removing said first and second mandrels from said helix and thereby producing a filament of refractory metal wire having a coiled-coiled body portion with transversely depending legs at each end consisting of a plurality of continuously wound primary turns, and

then bending only one selected primary turn of each of said legs in a direction and through an angle such that said selected primary turn of each leg is permanently deformed and opened and the portions of each of these legs beyond the respective selected bent primary turns extend longitudinally with respect to the coiled-coil body portion of the filament and are disposed in predetermined spatial relationship with respect to one another and are offset relative to the coiled-coil body portion of the filament.

2. The method set forth in claim 1 wherein the bending of said selected primary turns is achieved by applying deforming pressure to portions of said selected primary turns that are located on either side of a stationary pivot point that is established at an outwardly disposed surface of the respective turns.

3. The method set forth in claim 2 wherein; said first mandrel is removed by chemical dissolution, said second mandrel is mechanically withdrawn from the composite wire helix, and

the selected primary turns to be bent are located by contacting the side of the coiled-coil body portion of the filament and utilizing it as a reference surface for the turn-bending means.

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