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METHOD OF PRODUCING COILED FILAMENTS

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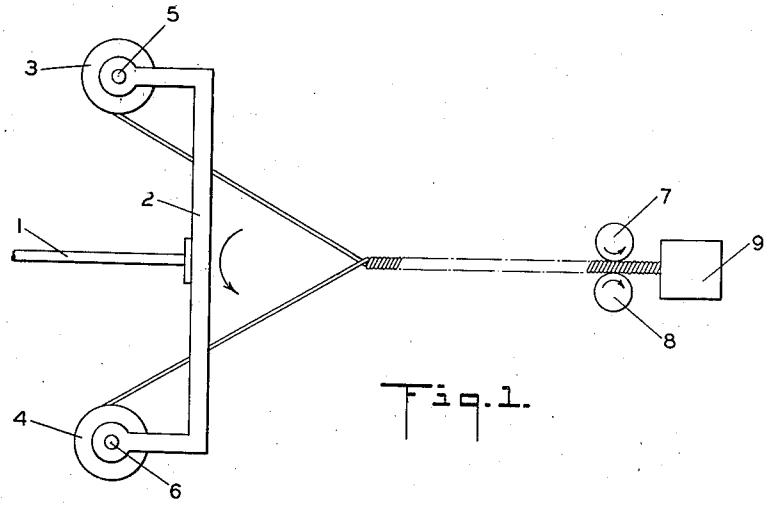

Fig. 1.

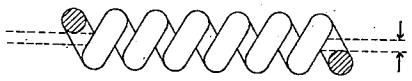

Fig. 2.

Fig. 3.

Ralph B. Thomas

INVENTOR

BY John J. Rogan

ATTORNEY

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METHOD OF PRODUCING COILED FILAMENTS

Ralph B. Thomas, Salem, Mass., assignor to Hygrade Sylvania Corporation, Salem, Mass., a corporation of Massachusetts

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5 Claims. (Cl. 140—149)

This invention relates to a method of coiling filaments such as are used in incandescent lamps, radio tubes or the like.

A principal object of the invention is to provide a method of producing a helically coiled metallic filament of extremely small internal diameter.

Another object is to provide a method of winding lamp or tube filaments to enable a greater variety of such filaments to be produced on existing high speed lamp or tube making machinery.

In the case of lamps having coiled incandescent filaments of tungsten or other similar metal, it has been found that "spot evaporation" is one of the important causes of shortening of lamp life. This spot evaporation probably results from the unequal migration of tungsten vapor between adjacent turns of the coil. I have further found that the spot evaporation effect is a function of the voltage-drop between adjacent turns, and any unevenness in temperature distribution between adjacent turns will disturb the normal or equal back and forth drift of the tungsten vapor between turns, resulting in the growth of one or more turns at the expense of adjacent turns. This condition aggravates itself during the operating life of the lamp and may finally result in burn-out or so-called "re-welding" and a consequent decrease in luminous deficiency.

Accordingly, another object of the present invention is to provide a coiled incandescent filament wherein the tendency to exhibit the above noted defects is materially reduced. In achieving this object the filament is wound in such a manner that the voltage drop per turn is reduced to the minimum consistent with the desired length and resistance of the filament as a whole.

A feature of the invention relates to a novel method of making helically coiled metal filaments wherein the spacing between turns is more uniform than is possible with ordinary filament coiling means.

Another feature relates to a helically coiled filament wherein the internal diameter of the coils may be even less than the diameter of the filament wire itself.

A further feature relates to the novel method of winding coiled filaments, whereby more uniform and more efficient incandescent lamps or the like may be produced.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the invention will be illustrated in schematic form and as embodied in one specific type of winding apparatus, it will be understood that this is done merely for purposes of explaining the inventive concept and not by way of limitation.

In the drawing Fig. 1 is a schematic diagram of one form of winding apparatus for practicing the invention.

Figs. 2 and 3 are enlarged views of portions of finished filaments produced according to the invention.

Referring to Fig. 1, the numeral 1 indicates a rotatable shaft carrying a frame 2 on which is supported the filament pay-off reel 3 and the mandrel pay-off reel 4. The filament wire is preferably of tungsten or other similar material such as is ordinarily used in incandescent lamps, while the mandrel wire is of molybdenum, or of steel as described for example in application Serial No. 752,016, filed November 8, 1934, patented January 12, 1937, Patent No. 2,067,746. Reels 3, 4, are mounted for rotation about respective spindles 5, 6, so that the wires may be paid off at the same time that the reels are being bodily revolved, and for this latter purpose the shaft 1 may be connected to any suitable source of motive power. Any well-known type of slack take-up or tension control means may be provided for the reels 3, 4, and/or for the wire as it is fed off the reels. Likewise, if desired, the frame 2 may be provided with any well known type of wire guide through which the filament wire and mandrel wire are guided to the coiling point.

In accordance with the present invention, instead of coiling the filament wire helically around a substantially straight mandrel, both the mandrel wire and the filament wire are twisted together as indicated in Fig. 1. Preferably the apparatus is so arranged that the axis of the twisted wires is in alignment with the shaft 1 or with the axis of rotation of frame 2. For this purpose, a pair of pressure rolls 7, 8 may be provided, these rolls being driven in the direction of the arrows, and frictionally engaging the twisted filament and mandrel to maintain the filament and mandrel under tension and to feed the twisted wires into a suitable receiving device 9. Thus as the rolls 7 and 8 revolve, the mandrel wire and filament wire are twisted about each other, the pitch of the twists being determined by the speed relations between shaft 1 and the rolls 7 and 8. If desired, reels 3, 4, may be adjustably mounted on frame 2 so as to vary their distance from the axis of rotation.

After the twisted wire and mandrel have passed the rolls 7, 8, they may be subjected to a suitable

heat treatment to set the turns of the tungsten filament in twisted condition, after which the mandrel wire may be removed by any well-known method for example by dissolving it in a suitable liquid such as mixture of 80% nitric and 20% sulphuric acids. The heat treatment for setting of the filament and the dissolving of the mandrel may be accomplished directly in the receiving device 9, or after the wire is removed from the receiving device.

It will be noted therefore that during the twisting operation as well as during the setting and mandrel dissolving operations, the mandrel wire is in close contact with adjacent turns of the tungsten filament throughout the entire length of the filament turns, thus insuring that when the mandrel is dissolved and the tungsten filament finished, the adjacent turns thereof are uniformly spaced from each other by a distance substantially equal to the cross section of the mandrel wire. Furthermore, during the twisting operation the mandrel and filament wires mutually support each other and there is very little tendency for the mandrel wire to become bowed.

While the drawing in Fig. 1 shows the mandrel wire of substantially the same cross section as the filament, it will be understood that this is done merely for purposes of illustration and if desired the mandrel may be of smaller cross section than the filament. Thus as shown in Fig. 2 the finished filament has a spacing between turns which is less than the diameter of the filament itself. It will also be noted that the internal diameter of the finished filament is less than the cross section of the filament wire.

In Fig. 3 there is shown a finished filament with the turns having a different pitch from the filament of Fig. 2. In this embodiment the filament was wound with a mandrel which was less than one-half of the cross section diameter of the filament wire as indicated by the dotted lines.

Various changes and modifications may be made herein without departing from the spirit and scope of the invention.

It will be understood that while the drawing shows the filaments of the single or primary coiled type, this coil filament may be itself coiled to provide secondary convolutions in any manner well-known in the art.

What I claim is:

1. The method of producing a coiled filament for lamps or the like which includes the steps of paying-off the filament wire and a fine wire mandrel from suitable pay-off reels, revolving said reels about a common axis to twist only said two wires together while maintaining the twisted wires under feeding tension, setting the filament wire in its twisted state, and then dissolving out only the twisted mandrel wire.

2. The method of producing a coiled filament for incandescent filament devices which includes the steps of twisting the filament and maintaining the coils spaced apart during the twisting-operation by a twisted wire mandrel, setting the filament in its twisted condition, and then removing only the wire mandrel.

3. The method of producing a coiled filament for incandescent filament devices which includes the steps of mutually twisting together only two wires to form concentric helices, the turns of one helix being wound between the turns of the other and spacing the turns of the other, setting one of said wires in its twisted state and then dissolving only the other twisted wire.

4. The method of producing a coiled filament for incandescent filament devices which includes the steps of twisting the filament wire only with a mandrel wire to form concentric helices in which the turns of the mandrel helix are wound between the turns of the filament helix and space the turns of the latter, setting the filament wire in its twisted condition and then removing the mandrel wire.

5. The method of producing a coiled filament for incandescent filament devices which includes the steps of mutually twisting only a tungsten filament and a fine wire mandrel to form concentric helixes in which the turns of the wire mandrel are wound between and serve to space the turns of the tungsten filament, setting the tungsten filament in its twisted condition, and then dissolving out only the mandrel.

RALPH B. THOMAS.