July 5, 1932. S. WADSTEN ET AL 1,865,490

METHOD OF PRODUCING UNIFORM LENGTH FILAMENTS

Filed Dec. 29, 1928

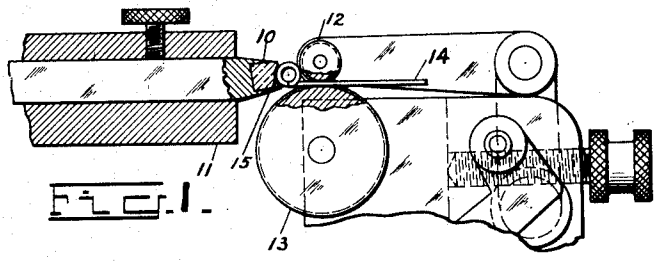


Fig. 1.

Fig. 2.

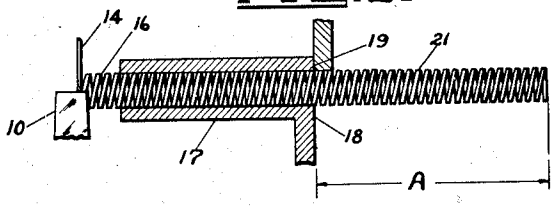


Fig. 3.

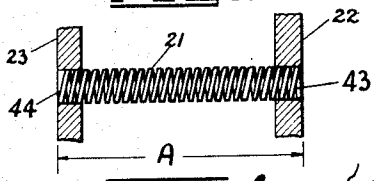


Fig. 4.

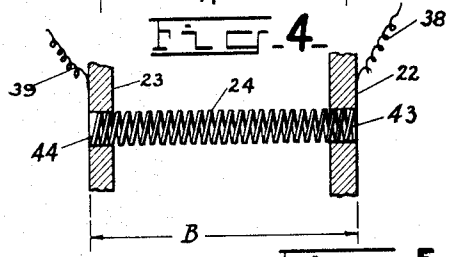


Fig. 5.

Fig. 7.

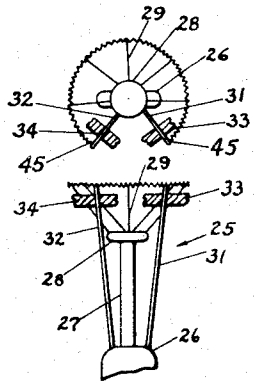


Fig. 8.

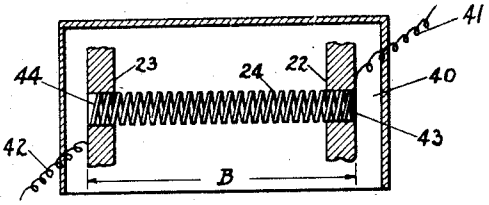
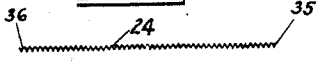


Fig. 6.



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UNITED STATES PATENT OFFICE

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METHOD OF PRODUCING UNIFORM LENGTH FILAMENTS

Application filed December 29, 1928. Serial No. 329,149.

This invention relates to the manufacture of incandescent electric lamps and relates more particularly to the production of a coiled filament of definite length for use in said lamps.

Incandescent electric lamps may be generally divided into two classes, first those employing a straight or uncoiled filament and second such lamps as employ a light source consisting of a fine filamentary wire wound into helical form. The present invention is concerned with the last mentioned type of filament which is generally known in the art as the concentrated type, the same being adapted for use in either a gas filled or evacuated bulb.

The coiling of a lamp filament to produce a light source is an important and exacting operation and it has been the practice to employ two methods of winding. First the method of winding a filamentary wire upon a mandrel, cutting the mandrel containing helix into definite lengths or sections, immersing the sections in an acid bath to dissolve the mandrels and subsequently dipping the mandrelless coils in a cleaning solution. The second method consists in coiling a filamentary wire to helical form in the absence of a mandrel, in which case it is only necessary to dip the filaments in the cleaning solution.

When producing a light source or section of filament for use in a lamp of a given wattage certain conditions must be carefully observed and strictly adhered to. The length of the selected filament wire contained in the light source must be exact so that the proper resistance will be obtained for a given wattage lamp. Each given length of wire must be contained in a helix of a given number of terms, the pitch of the helix must be maintained uniform and the outside diameter of the helix held constant.

It has been found practical to meet the above requirements on the mandrel coil winding machines and especially on a mandrelless coil winding machine shown in Patent 1,670,499 in which a filamentary wire is wound to helical form in the absence of a mandrel and automatically cut into sections, each section containing equal lengths of wire.

Although the above mentioned mandrelless coil winding machine may operate to meet all the requirements of the rating data, that is, in providing the proper diameter, pitch and length of wire contained in a coiled section, it does not follow that all the coiled sections are of the same over-all length.

In winding of filaments on a mandrel the filaments may be cut to a definite length while on the mandrel, but when removed therefrom the release of internal tension or other force results in the production of filaments which although containing equal lengths of wire still possess differences in their over-all lengths.

It is an object of the present invention, therefore, to produce a coiled filamentary body which will meet requirements as to diametrical dimensions, pitch and length of wire contained in a coiled section and at the same time have uniform over-all lengths.

Another object of the invention is to provide lamp filaments consisting of coiled sections of equal over-all lengths.

Another object of the invention is to provide a method of producing coiled filamentary sections having uniform over-all lengths and in treating said sections preparatory to incorporation in a lamp.

Another object of the invention is to provide a simple method of setting and cleaning lamp filaments.

The advantage of the above uniformity in the over-all lengths of the filament resides in the adaptability of such filaments for use in connection with their automatic application to a lamp stem.

It will be understood that in the manufacture of an incandescent electric lamp the internal structure includes a number of glass parts which may comprise an exhaust tube, a flare tube and an arbor consolidated together by fusion and having sealed in the fused portion a pair of leading-in wires or conductors. The leading-in wires extend upwardly to the exposed end of the arbor which contains a plurality of what are termed, support wires. These wires have their ends embedded in the arbor and extend radially therefrom. The free ends of the support wires are

formed with hooks or pig tails to receive and hold a lamp filament and the ends of the filament are secured to ends of the leading-in wires.

Heretofore the operation of securing the filament to the lead-in wires was performed manually, the operator upon picking up a filament connected one end by clamping or welding to a lead-in wire then inserted the filament into the support wires and finally connected the other end of the filament to the other lead-in wire or conductor. In performing this operation it was possible for the operator to slightly adjust the lead-in wire in case the filament was too long or too short.

In the automatic application of a filament to leading-in conductors, however, it is necessary to position the conductors in a definite spaced relation, therefore, unless all filaments possess exactly the same over-all length difficulties arise in that the filament may fail to reach the positioned lead-in wire or may over-lap the same.

In the first case the mounting operation will be a failure while in the second case a section of the filament will be short circuited changing the rating of the lamp.

In accomplishing the object of the present invention a filament may be wound on a coil winding machine, but instead of winding the coil in the form of a helix having the turns in spaced relation the coil may be wound in what is termed, a tight winding, that is each turn would be in contact with the adjacent turn or with no space existing therebetween. When so wound the coil may be cut into sections of given lengths which may be designated as the cutting lengths and then stretched so as to space the turns of the coil to such degree as to make the over-all length of the coiled section a given dimension. Coils of this character may then be employed in connection with an automatic mounting operation since all the coiled sections have a given over-all length.

On the other hand the same result may be obtained by winding the coils on a coil winding machine with the turns in spaced relation, but with a greater number of turns per inch, or unit of length and with a slightly larger outside diameter than specified for the coil when used as a light source. The coil may then be stretched to a specified length or specified number of turns per inch and a given diameter, thus giving the coils a uniform over-all length and at the same time maintaining the proper length of wire in the coil.

In practicing the method for preparing coils for automatic mounting operation, it has been found that certain advantageous steps are possible, since while the coils are held in position after stretching they may be flashed by an electric current either in the air or an inert gas. When flashed in air the carbon or other foreign material clinging to the wire is oxidized and the subsequent flashing in an inert gas serves to remove the oxide and flash off any remaining foreign substance or to reduce any tungsten oxide that may be present.

From the foregoing it will be evident that the present invention contemplates a method of producing filamentary bodies to serve as a light source for an incandescent lamp having specified dimensions as to coiled diameter, pitch, length of wire and over-all length. The latter requirement making the coil practical for use in connection with the automatic mounting of the coil.

The invention will be more fully understood from the accompanying drawing which diagrammatically represents the steps of the method and its relation to the automatic mounting of the filament.

Fig. 1 shows a diagrammatic representation of a coil winding die with driving rollers to propel a wire for formation into a helix.

Fig. 2 shows a coiled wire as it issues from a die and moves in position to be severed by cutting knives, the coil shown is greatly exaggerated in size for the purpose of clearness.

Fig. 3 shows a section of coiled wire cut from a continuous length.

Fig. 4 shows the section of coiled wire illustrated in Fig. 2 but stretched to a given length.

Fig. 5 shows the stretched length of coiled wire disposed in a chamber containing an inert gas in which the coil may be heated.

Fig. 6 shows a length of coiled wire stretched to length, heated and cleaned ready to be applied to a lamp stem, in this view the coiled section more nearly approaches the proportions of the actual filament.

Fig. 7 is a plan view of a stem with the filament mounted thereon and illustrates the definite position of the leading-in wires and

Fig. 8 is a side view of a portion of a lamp stem having a stretched filament applied thereto.

Although the present invention is applicable to filaments wound on a mandrel the present example of one embodiment of the invention applies to coils wound in the absence of a mandrel.

The patent above referred to fully discloses a machine for producing coils without the aid of a mandrel and as shown in Fig. 1 of the present drawing such machine may comprise a die 10 supported in a holder 11. A pair of upper and lower driving or force rollers 12 and 13 frictionally engage a wire 14 and move the same endwise into the die which is provided with a coil bending cavity 15. At the edge of the cavity is a lip (not shown) which operates to space the turns of the coils as they issue from the die. The pitch of the coil may be varied by changing the relative position of the die with respect to the driv-

ing rollers and if an extremely tight or close turned wound coil is desired the spacing lip may be omitted although a tight wound coil may be produced by a die with a lip by proper adjustment of the die with respect to the direction of movement of the wire under the action of the driving rollers.

Machines for winding coils in accordance with the above are known to those skilled in the art and a continuous length of helically coiled wire of a given pitch may readily be obtained.

As the wire 14 is wound it issues from the die in the form of a continuous helix 16 as shown in Fig. 2 and may pass through a guide 17 and between cutting edges 18 and 19 which serve to sever a section 21 of a given length.

In the mandrelless coil winding machine above referred to the severed coiled section 21 contains a predetermined amount of wire, since in accordance with the operation of the machine the cutting knives are operated through the agency of a measuring drum so arranged that when a given point on the wire travels through a given distance the cutters operate, thus the severed section always contains a given amount of wire.

If slight variations in the pitch and diameter of the coil exist however, the over-all length of the sections may vary.

The over-all length of the sections may be construed as the length of the body of the coil from end to end indicated by the letter "A".

In accordance with the present invention a continuous coil may be wound with the pitch of the turns relatively close or with a greater number of turns per unit of length than desired in the section when secured to a stem as shown in Fig. 2.

The section 21 may then be severed and the ends gripped between pairs of jaws 22 and 23. When so held the pairs of jaws may be separated a given distance to stretch the section to increase its over-all length, indicated as "B", and thus reduce the number of turns per unit of length giving a section 24 as shown in Fig. 4.

In determining dimension "B" the mounting of the filament is considered and as shown in Figs. 7 and 8 a stem 25 may be taken as in position to have a filament automatically applied thereto. The stem shown comprises a press 26 from which an arbor 27 extends. The free end of the arbor is provided with a button 28 having support wires 29 extending therefrom, the exposed ends of the support wires having hooks or pig tails to receive and retain the filament. Leading-in wires 31 and 32 are held in definite fixed relation by pairs of jaws 33 and 34 thus the distance "B" or over-all length of the filament section must be such that ends 35 and 36 will lie in position on the leading-in wires when the filament is disposed in its circular position in the support wires. The circumferential dimension of the filament when on a stem must therefore be equal to "B" without changing the number of turns per unit of length in the coiled section.

When filamentary sections are produced by the above described method they may either be carried by the jaws 22 and 23 to position for attachment to the leading-in wires or a quantity of such filamentary sections may be fed to mechanism which will automatically mount the filament on the support wires to be secured thereto by welding or clamping as desired.

The present invention however, further contemplates the step of cleaning the filament. It is well known that when using what is termed "black wire" difficulty is encountered in cleaning the coils. Black wire consists of drawn tungsten in which a lubricant such as "aquadag" is used during the drawing operation. This lubricant adheres to the wire and if not removed is detrimental to the life of a lamp in which the filament may be incorporated. Heretofore the coils or filaments were cleaned by immersion in sodium hydroxide and a solution of sodium bichromate.

It has been found that when practicing the present method it lends itself to the step of cleaning since while the coiled sections are held between the jaws 22 and 23 and stretched they may be moved into a chamber 40 containing a gas such as hydrogen or nitrogen or a mixture of suitable gases and electric current may be passed through the filament by means of conductors 41 and 42. By this heating of the filament the deleterious substances are destroyed and removed at the same time the filament takes a permanent set.

It has also been found of advantage to flash or heat the filament in air directly after the stretching operation in which case electric current may be passed through conductors 38 and 39. The air flashing is not essential but may be employed if desired since it oxidizes the carbonaceous material or makes the same more easily removable when the filament is flashed in an inert gas for a final cleaning step.

From the foregoing it will be evident that the present method not only provides an advantageous mode of producing filament sections of equal over-all length, but combines with this feature the operation of setting and cleaning which may be accomplished in an economic and effective manner.

When practicing the present method to produce a filament say for a 60 watt lamp, a tungsten filament wire of 1.85 mils diameter may be employed. This wire is coiled into a continuous helix having an outside diameter of about 10.8 mils and having 390 turns per inch. A section equal to "A" is then severed and stretched about 5% to give

a section having 370 turns per inch and an over-all dimension equal to "B". It is understood that the dimension "A" is a determined dimension and selected so that when the filament is stretched the dimension "B" will be such that the ends of the coiled section will take their proper positions on the leading-in conductors which are in a given fixed relation for the type of lamp in which the filament is to be used.

The above description gives as a practical example of the invention, the initial winding of a spaced coil having a greater number of turns per unit of length than the final coil. The initial coil may, however, as hereinbefore mentioned, be wound with the turns in contact and subsequently stretched and flashed. When winding a coil with the turns in contacting relation on the mandrelless coil winding machine, for example, an advantage is gained in that the lip of the coil winding die may be omitted to the end, that the construction of the die is simplified. This is important since coil winding dies are generally made from a diamond and if the construction can be made less complicated the cost of producing such dies is reduced and by reason of the absence of the lip there is less danger of breakage.

Certain advantages are present with both modes of procedure in carrying out the present method and it is evident that the underlying idea of the production of an initial coil of a greater number of turns per unit of length stretched to a coil of a desired number of turns per unit of length is common to either the tight wound or the spaced coil mode of procedure. Furthermore a filament produced in accordance with the above method possesses certain properties or novel characteristics which distinguishes it from coils as heretofore produced, as will be evident from the following.

As above set forth a coiled section having a given number of turns per unit of length is severed from a coil of indefinite length. The severed section is then gripped between jaws 22 and 23. These jaws secure a plurality of turns of the coil, these turns which constitute the terminals of the filament are indicated as 43 and 44. Each end is so held that their initial pitch is maintained during the stretching operation. This results in a coil body or section wherein the major or light giving portion of the filament possesses a lesser number of turns per unit of length than do the terminals of the filament. It has been found that when holding the ends of the filament between jaws during the heat treatment that the secured portions of the filament remain substantially cool and thus retain their initial malleability, that is, they are less brittle or less liable to break under stress than the portion of the filament which has been subjected to a relatively high temperature heat treatment.

It will be understood that the ends of the filament are secured to leading-in conductors, the ends of which are usually bent over and clamped upon the end of the filament. By making the jaws 22 and 23 of slightly greater width than the width of the clamps at the end of the conductors the unheated portions or terminals of the filament will be of sufficient length to extend slightly from the side of the clamp of the leading-in wires or conductors thus giving a turn or half a turn of pliable wire 45 adjacent to the clamping point. A filament so constructed tends to resist breakage due to vibration and since it has been found that in a lamp filament the portion of wire adjacent to the clamp is subjected to severe strain and since the present construction serves to improve the strength of this portion of the filament, a new and decided advantageous result is attained. Furthermore, during the clamping operation it is necessary in order to properly secure the filament to crush the same between the overlapped portions of the leading-in conductor. In a filament such as produced by the present method the terminals being pliable or free from brittleness are more readily clamped without breaking away from the main portion of the filament.

When securing the terminals of the filament between jaws during the stretching and subsequent heat treatment, the portion held by the jaws obviously do not receive the same degree of cleaning as the main portion of the filament. In practice it has been found that no detrimental effects result from this absence of cleaning at the terminals since when the filament is mounted on a stem the terminals remain relatively cool. If necessary, however, the filament may be given an additional cleaning step by dipping in any suitable cleaning solution known to the lamp making art.

It will be understood that although a filament having terminals of greater strength than the main body of the filament are advantageous with a clamping operation they will also be desirable if the ends of the filament are to be welded or otherwise secured to the leading-in conductors. Since in this case as in the clamping, a sufficient amount of the pliable portion of the wire may be disposed intermediate the light giving portion.

It is to be understood that the above is only an example of one practical application of the present invention and that the various dimensions may be varied to suit lamp making requirements and furthermore various modifications may be resorted to without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. The method of making a lamp filament

which comprises, winding a wire to helical form having a given number of turns per unit of length, heating the filament to remove deleterious substances, stretching the filament to a given over-all length and uniform pitch and again heating in a gaseous atmosphere.

2. The method of making a coiled lamp filament having a predetermined over-all length which comprises winding a wire to helical form with a greater number of turns per inch than required when used as a light source, in stretching the helix until the same contains a lesser number of turns per inch and maintaining a uniform pitch in the stretched portion.

3. The method of making a coiled lamp filament to constitute a light source having a given over-all length, which comprises winding a wire into a helix having a given number of turns per unit of length, in stretching the helix to vary the number of turns per unit of length and in maintaining a uniform pitch in the stretched portion.

4. The method of producing a coil of a predetermined over-all length which comprises winding a filament wire into a continuous helix severing a section of said helix, subsequently stretching said section to a given over-all dimension and maintaining a uniform pitch in the stretched section.

5. The method of producing a helical coiled section having a definite over-all length which comprises coiling a wire to helical form, severing a section of the helix, in stretching the said section to a given over-all dimension and in maintaining a uniform pitch in the stretched section.

6. The method of producing a coiled lamp filament having a predetermined over-all length which comprises winding a wire to produce a helically coiled section having a given number of turns per inch, in stretching said section to produce a coiled section of a given over-all length with a lesser number of turns per inch and in maintaining said lesser number of turns of uniform pitch.

7. The method of producing a coiled lamp filament having a predetermined over-all length which comprises winding a wire into a coiled section having a given outside diameter and a given number of turns per inch, in stretching said section to reduce the outside diameter and the number of turns per inch and in maintaining a uniform pitch in the stretched section.

8. The method of manufacturing lamp filaments which comprises winding a wire into a helix having an over-all length of a given dimension, in stretching the helix to provide a filament having a length of a different over-all dimension and in maintaining a uniform pitch in the stretched helix.

9. The method of making a lamp filament which comprises winding a wire into a helix having a given over-all length, stretching said helix to change its over-all length, in heating the stretched helix to a relatively high temperature and in maintaining a uniform pitch in the heated stretched helix.

10. The method of making a lamp filament which comprises winding a wire into a helix having a given over-all length, stretching said helix to change its over-all length, in heating the stretched helix while in an inert environment and in maintaining a uniform pitch in the stretched helix.

11. The method of making a lamp filament which comprises winding a wire into a helix having a given number of turns per unit of length, severing a section from said helix, stretching said section to a given over-all length, heating the said section and in maintaining a uniform pitch in said stretched section.

12. The method of making a lamp filament which comprises winding a wire into a helix having a given number of turns per unit of length, severing a section from said helix, stretching said section to a given over-all length, in heating the said section while in an inert atmosphere and in maintaining a uniform pitch in the stretched section.

In testimony whereof, we have hereunto subscribed our names this 28th day of December, 1928.

STEN WADSTEN.
CHARLES W. HUNT.