FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

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The present invention relates to filament-mounting apparatus and, more particularly, to a device for stretching a mounted filament by repositioning a portion of the lead wires.

In the manufacture of incandescent lamps, a coiled filament (produced by windin a primary coil around a second mandrel) is most commonly utilized because it is easier to mount with automatic filament-mounting machines than the single primary coil. In addition, such coiled filament is more subject to the radial, heat exchange effect of the adjacent turns in the coiled filament and the limited heat transfer to the argon gas within the bulb. During the second coiling of the coiled filament, the first mandrel utilized for the primary coiling is left in place to prevent distortion of the primary coiling and second coiling. When this first mandrel is acid-dissolved out of the coiled filament, the stresses induced in the filaments during the second coiling cause spring-back in the coiled filament so that such filaments vary about 4.0 mm. in length and hence in turns per inch, even though each such coiled filament contains the same total length of uncoiled tungsten wire.

The turns per inch in the mounted filament is critical and influences the initial efficiency as measured in lumens per watt; the actual initial efficiency for design life also measured in lumens per watt; and the life of the finished incandescent lamp as measured in hours. If, for example, the number of turns per inch in the mounted filament is below the specified number, the finished lamp may have a long life but a low initial efficiency and low actual initial efficiency for design life will result. If, however, the number of turns per inch is above the specified number, undesirable heat results even though high initial efficiency and high actual initial efficiency for design life are achieved. As an example, a one turn per inch variation from the specified turns per inch in the mounted coiled-coil filament produces a 1% change in the initial efficiency and a 7% change in the life of the lamp.

Hereinafter, the legs of the coiled-coil filament were mounted in the hooks provided in the lead wires of the stem by a filament-mounting machine of the type shown in U.S. Patent No. 1,907,532, issued May 9, 1933, to J. Flaws, Jr., which filament-mounting machine picked up the coiled filament and positioned the filament legs in the hooks and closed the hooks about the filament legs. The mounted filament was then stretched to a fixed lighted-filament length (i.e., length of filament between the hooks in the lead wires) by filament-stretching apparatus of the type shown in U.S. Patent No. 2,736,344, issued February 28, 1956, to L. E. Dilts, to provide a definite and uniform number of turns per inch in the mounted filament, thereby forming a filament mount of the type shown in U.S. Patent No. 2,085,578, issued June 29, 1937, to J. Flaws, Jr.

To accomplish this stretching of the mounted filament described in the above-mentioned U.S. Patent No. 2,736,344, fixed fingers brace the lead wires from the inside of the lead wires and at points between the tie wires and the mounted filament. Bending fingers then squeeze inwardly those portions of the lead wires disposed between the press and the tie wires to bend the lead wires about the fixed fingers with resultant spreading of the filament. Alternatively, the fixed fingers may engage the lead wires from the outside of the lead wires at points between the press and the tie wires and the bending fingers may engage the lead wires from the inside of the lead wires at points between the tie wires and the mounted filament to accomplish the same result.

In either case when the pressure on the intermediate portions of the lead wires is released by retraction of the fixed fingers and the bending fingers, such intermediate portions of the lead wires supposedly bear against the loops in the tie wires which retain such lead wires in the desired bent position and attendantly the filament is retained thereby in the desired stretched position.

However, during the repositioning of the portions of the lead wires between the tie wires and the mounted filament by the bending fingers of the apparatus as shown in the above-described patent, the other portions of the lead wires between the press and the tie wires are bowed inwardly about the fixed fingers as a fulcrum. When such other portions of the lead wires between the press and the tie wires are released by the retraction of such apparatus, the spring-back of such other portions to their normal pre-bowed position (which spring-back is dependent upon the resiliency of the lead wires) affects the filaments of the mounted filament and the final position of the bent portions of the lead wires in the loops of the tie wires.

The resiliency of the other portions of the lead wires between the press and the tie wires varies from one lot of lead wires to another. In addition, during the fabrication of the filament, the degree of oxidation of the other portions of the lead wires between the press and the tie wires also varies, thus further affecting the resiliency of such other portions. Another factor affecting the achievement of uniformly stretched filaments is the resiliency of the tie wires, the loops of which must retain the final stretched position of the bent portions of the lead wires (between the tie wires and the mounted filament). Yet another factor is the space of such loops in such tie wires, which loop position is further a function of the addition depth of the tie wires into the arbor button.

As a result of the above-mentioned defects and disadvantages of the conventional apparatus for stretching a mounted filament to a predetermined stretched (lighted-filament) length, such conventional mount apparatus has failed to consistently provide a uniform number of turns per inch in the mounted filaments.

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of and objections to prior-art practices by the provision of an improved filament-stretching device which consistently and reliably provides a uniform number of turns per inch in a mounted filament for an incandescent or fluorescent lamp.

Another object of the present invention is the provision of an improved filament-stretching device which prevents the bowing of the portions of the lead wires disposed between the press and the tie wires thereby eliminating the undesirable spring-back of such portions after the completion of the filament-stretching operation.

Still another object of this invention is to provide an improved filament-stretching device which eliminates the deleterious effect of the varied stretching operation, such as lead-wire spacing, tie-wire insertion depth and resiliency of the tie wires.

Yet another object of the present invention is to provide an improved filament-stretching device which utilizes a bending arm substantially maximum in length to reposition oxidized portions of the lead wires.
3,058,497 3 thereby facilitating the repositioning of the lead wires and minimizing the effect of lead wire resiliency in the filament-stretching operation.

The aforesaid objects of the present invention, and other objects which will become apparent as the description proceeds, are achieved by providing a pair of gripping members which rigidly clamp portions of the lead wires between the tie wires and the mounted filament, thereby immobilizing the portions of the lead wires between the press and the clamped portions and eliminating bowing therein during the filament-stretching operation, and a pair of lead-wire-repositioning members which are disposed adjacent the mounted filament and engage the portions of the lead wires which are to be repositioned thereby providing a bending arm (substantially maximum in length) for the bending of such portions and thus facilitating the bending operation, the lead-wire-repositioning members being operable to reposition the lead wires and thus stretch the mounted filament a predetermined distance thus providing a uniform number of turns per inch in each mounted filament.

For a better understanding of the present invention referred to above should be had to the accompanying drawings wherein like numerals of reference indicate similar parts throughout the several views, and wherein—

FIG. 1 is a side-elevational view of the improved stretching device of the present invention disposed at a filament-stretching station of a filament-mounting machine and showing the filament-stretching device of the present invention at the start of the filament-stretching operation, with portions of the filament-stretching device shown in section to illustrate the details of its construction.

FIG. 2 is a plan view taken along the line II—II of FIG. 1 in the direction of the arrows.

FIG. 3 is a vertical-sectional view of the filament-stretching device and showing such filament-stretching device at the end of the filament-stretching operation.

FIG. 4 is a vertical-section view along the line IV—IV of FIG. 3 in the direction of the arrows.

FIG. 5 is a view similar to FIG. 4, taken along the line V—V of FIG. 3 in the direction of the arrows.

FIG. 6 is a fragmentary horizontal-sectional view taken along the line VI—VI of FIG. 3 in the direction of the arrows.

FIG. 7 is a side-elevational view of a filament mount carried by a head of the filament-mounting machine as such head and filament-mount index into the filament-stretching station, preparatory to the stretching of the mounted filament a predetermined amount by the filament-stretching device of the present invention.

FIG. 8 is a view similar to FIG. 7 and showing the portions of the lead wires between the tie wires and the mounted filament securely clamped by the gripping jaws and further showing the lead-wire-repositioning fingers in position between the portions of the lead wires which are to be repositioned preparatory for the filament-stretching operation.

FIG. 9 is a view similar to FIGS. 7, 8 and 9 and showing the position of the lead-wire-repositioning fingers at the end of the filament-stretching operation.

FIG. 10 is a view similar to FIGS. 7 through 9 and showing the final stretched condition of the mounted filament preparatory to the indexing of such filament mount from the filament-stretching station.

With specific reference to the form of the invention illustrated in the drawings, and referring particularly to FIGS. 1 and 7, a filament mount is indicated generally by the reference numeral 10.

This filament mount 10 is secured by means of its exhaust tubulation 12 and its arbor 14 in tubulation-gripping jaws 16 and arbor-gripping jaws 18 respectively of the head of a filament-mounting machine (not shown, but of the type disclosed in the above-mentioned Patent No. 2,736,344). The head and the filament mount 10 secured therein are indexable through a plurality of work stations including the filament-stretching station, shown in FIGS. 1 and 3.

After the head and filament mount 10 have been indexed into the filament-stretching station, as shown in FIG. 1, a pair of lead-wire gripping jaws 20 (adjacently mounted on a lever 22 pivoted at 24 on the frame portions 26 of the filament-mounting machine, not shown) are rotated in clockwise direction from the solid-line position shown in FIG. 1, to the dotted-line position shown in FIG. 2. The lead wires 28 and 30 upon which the filament mount 10 (FIG. 8) during this clockwise movement, as viewed in FIG. 1, the gripping jaws 20 make straight-line contact with the lead wires 28 and 30, between the points where tie wires 32 are welded to the lead wires 28 and 30 (FIGS. 7 to 10), and the depending ends of such lead wires 28 and 30 upon which a filament 34 which is to be stretched is mounted. These gripping jaws 20 position the lead wires 28 and 30 parallel to the longitudinal axis of the filament mount 10, thus compensating for any misalignment thereof.

The means utilized to rotate the gripping jaws 20 from the solid-line position, shown in FIG. 1, to the dotted-line position shown in such figure comprises a connecting rod 36 which connects the lever 22 in the conventional manner to a lever driven by a first cam means on the main cam shaft (not shown) of the filament-mounting machine.

To provide mounting means for the horizontal movement 4 of a cooperating pair of lead wire gripping jaws 38 (FIGS. 1 and 2) into engagement with the positioned lead wires 28 and 30 and thus securely clamp such lead wires against the gripping jaws 38, such gripping jaws 38 are limitedly slidable on a body 40 which is slidable mounted by means of a bottom plate or slide 42 on the frame portions 26. As a result of this clamping of the lead wires 28 and 30, the portions of the latter between a press 43 of the mount 10 and the clamp are immobilized, thus preventing bowing therein during the repositioning of the remaining portions of such lead wires. In order to provide filament-stretching means which move forward simultaneously with the cooperating gripping jaws 38, lead-wire-repositioning fingers 44 are pivotally mounted at 46 (FIGS. 3 and 6) on the bottom plate 42 within an aperture 48 provided between the upper portions of the body 40 and the bottom plate 42. As shown in FIG. 8, these repositioning fingers 44 are inserted between the lead wires 28 and 30 and then moved outwardly into engagement therewith to the position shown in FIG. 9 to bend such lead wires outwardly and thus simultaneously stretch the mounted filament 34 from an initial lightened-filament length 4, (FIG. 8) to a lightened-filament length 2 (FIG. 9).

In order to move the repositioning fingers 44 outwardly from the substantially closed position, shown in FIGS. 2 and 8, to the open or filament-stretching position shown in FIGS. 6 and 9, the right-hand ends of such repositioning fingers 44 (FIGS. 2, 3 and 6) are biased away from each other by a compression spring 50 so that rollers 52 (adjacently mounted on the fingers 44) are spring-biased into engagement with cam surfaces 54 carried by an operating slide 56. This operating slide 56 is operable to also cause horizontal reciprocating movement of the body 40, the repositioning fingers 44 carried by the body 40 and the cooperating gripping jaws 38 slidably mounted on such body 40 to perform their above-described functions.

To cause the operating slide 56 to move the body 40 to the left, as viewed in FIGS. 3 and 6, when such operating slide 56 is moved in this direction, such operating slide 56 is connected to the body 40 by compression springs 62. So that such operating slide 56 may continue its movement to the left after the bottom plate 42.
of the body 40 engages a stop 78, such operating slide 56 carries an upstanding pin 58 which rides in a longitudinal slot 60 in the body 40. The pin 58 is held in normal engagement with the right-hand end of such longitudinal slot 60 by the action of the springs 62, which bias the operating slide 56 away from the bottom plate 42. To enable the body 40 to turn to move the gripping fingers 38 to the left during similar movement of the form, the gripping fingers 38 carry upstanding pins 64 (FIGS. 1, 2 and 3) which are reciprocable in longitudinal slots 66 in a cover plate 68 on the body 40 and such pins 64 are urged by compression springs 70 into engagement with the left-hand end of such longitudinal slots 66.

The drive means for the operating slide 56 comprises a lever 72 pivoted at 74 on the frame 26, and connected by a pin and slot arrangement 76 to such operating slide 56. The lever 72 is connected in the usual manner to a connecting rod 78 extending from a second cam means on the main cam shaft (not shown) of the filament-mounting machine.

Counterclockwise movement of the lever 72 by the second cam means causes the operating slide 56, the body 40 (pushed by the compression springs 62) the repositioning joggles 44 (mounted on the body 40) and the gripping jaws 38 (slidably carried by the body 40) to move to the left, as viewed in FIGS. 1 and 3, from the solid-line position shown in FIG. 1 to the position shown in FIG. 3. During this movement the gripping jaws 38 clamp the lead wires 28 and 30 in straight-line contact against the already positioned gripping jaws 26.

Continued movement of the operating slide 56 to the left causes the body 40 to continue its movement to the left relative to the now stationary gripping jaws 38 until the bottom plate 42 of such body has moved a distance $l_1$ (FIG. 1) and engages the stop 78, during which continued movement the compression springs 70 increase the clamp pressure on the lead wires 28 and 30. It will be understood from a consideration of FIGS. 1 and 3 that when the lower plate 42 of the body 40 engages the stop 78, the repositioning fingers 44 on the body 40 have been inserted between the lead wires 28 and 30 in the position shown in FIG. 8.

As shown in FIG. 3, the operating slide 56 continues its movement to the left (with respect to the now stationary body 40 and repositioning fingers 44) a distance $l_2-l_1$ since the pin 58 moves from the right-hand end of the longitudinal slot 60 (FIG. 2) to the left-hand end of such slot, as shown in FIG. 3, thus enabling such additional movement. Such additional movement of the operating slide 56 causes the cam surfaces 54 to move the rollers 52 inwardly toward each other with attendant diverging movement of the left-hand or operating ends of the repositioning fingers 44 away from each other from the position shown in FIG. 8 (into engagement with the lead wires 28 and 30), to the position shown in FIG. 9 thereby bending the lead wires 28 and 30 and stretching the mounted filament 34 a predetermined amount namely $d_2-d_1$.

Thereafter, clockwise movement of the lever 72 by the second cam means (not shown) moves the operating slide 56 to the right to permit the cam surfaces 54 (aided by the spring 50) to retract the operating ends of the repositioning fingers 44 from the position shown in FIG. 9 to the position shown in FIG. 8, and to permit the pin 58 to once more engage the right-hand end of the longitudinal slot 60, so that the operating slide 56 to the right the body 40 and operating slide 56 thereafter move as a unit. When the repositioning fingers 44 are retracted the mounted filament 34 assumes the position shown in FIG. 10, thus providing a final lighted-filament length $d_3$ therein.

Further movement of the operating slide 56 and the body 40 to the right gradually releases the compressive clamping pressure exerted by the springs 70 on the gripping jaws 38 and the lead wires 28 and 30 and permits the retraction of such gripping jaws 38 with the body 40 when the pins 64 again engage the left-hand end of the longitudinal slots 66. The body 40, the gripping jaws 38, the repositioning joggles 44 and the operating slide 56 then move to the right to the starting position shown in FIG. 1.

During this latter portion of the retraction movement of the operating slide 56, body 40, gripping jaws 38 and repositioning fingers 44, the gripping fingers 20 are rotated in a counterclockwise direction from the dotted-line position shown in FIG. 1 to the solid-line or starting position shown in such figure by operation of the first-mentioned cam means.

It will be recognized by those skilled in the art that the objects of the present invention have been achieved by the provision of an improved filament-stretching device which consistently and reliably provides a uniform number of turns per inch in the lighted-filament length of a mounted filament. This improved filament-stretching device prevents bowing of the portions of the lead wires disposed between the press and the tie wires thereby eliminating undesirable spring-back of such portions after the completion of the filament-stretching operation. In addition, this improved filament-stretching device eliminates certain variables herefore encountered in the filament-stretching operation, such as lead-wire spacing, insertion depth of the tie wires into the anchor button and the resiliency of both the lead wires and the tie wires.

While in accordance with the patent statutes one best known embodiment of the present invention has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. Apparatus for stretching the filament of a lamp mount having a press provided with a pair of longitudinally extending lead wires rigidly secured thereto and having a filament mounted on the unsecured ends of the lead wires, said apparatus comprising a first pair of gripping jaws disposed adjacent said lead wires, means connected to said first pair of gripping jaws and operable to move said first pair of gripping jaws into engagement with said lead wires to position said lead wires on the longitudinal axis of the lamp mount, said first pair of gripping jaws being operable thereafter as a clamping anvil, an operating slide disposed adjacent said lead wires, means operatively associated with said operating slide for moving the latter toward and away from said lead wires, a body resiliently connected to said operating slide and adapted to be driven thereby along a limited path of movement, said operating slide being operable to continue its movement toward said lead wires when such body reaches the end of its path of movement toward said lead wires, a second pair of gripping jaws slidably mounted on said body and operable to secure a portion of said lead wires in straightline contact against said first pair of gripping jaws to form a clamp during movement of said operating slide and said body toward said lead wires whereby preventing movement of the portions of the lead wires between the press and the clamp during bending of the other portions of the lead wires between the clamp and the mounted filament, a pair of repositioning fingers mounted on said body and movable with said body into position between said lead wires and cam means carried by said operating slide for causing said repositioning fingers to engage the lead wires in a manner to provide a bending arm substantially maximum in length and to cause said repositioning fingers to reposition said other portions of said lead wires beyond said clamp thereby stretching the mounted filament to a predetermined lighted length.

2. Apparatus for stretching the filament of a lamp mount having a press provided with a pair of longitudinally extending lead wires rigidly secured thereto and
having a filament mounted on the unsecured ends of said lead wires, said apparatus comprising a first pair of gripping jaws disposed adjacent said lead wires, means connected to said first pair of gripping jaws and operable to move said first pair of gripping jaws into engagement with said lead wires to position said lead wires on the longitudinal axis of the lamp mount, said first pair of gripping jaws being operable thereafter as a clamping anvil, an operating slide disposed adjacent said lead wires, means operatively associated with said operating slide for moving the latter toward and away from said lead wires, a body resiliently connected to said operating slide and adapted to be driven thereby, stop means disposed in the path of movement of the body toward said lead wires for arresting the movement of the body, said operating slide being operable to continue its movement toward said lead wires when such body engages said stop means, a second pair of gripping jaws slidably mounted on said body and operable to secure a portion of said lead wires in straight-line contact against said first pair of gripping jaws to form a clamp during movement of said operating slide and said body toward said lead wires thereby preventing movement of the portions of the lead wires between the press and the clamp during bending of the other portions of said lead wires between the clamp and the mounted filament, a pair of repositioning fingers mounted on said body and movable with said body into position between said lead wires and cam means carried by said operating slide for causing said repositioning fingers to engage the lead wires in a manner to provide a bending arm substantially maximum in length and to cause said repositioning fingers to reposition said other portions of said lead wires beyond said clamp thereby stretching the mounted filament to a predetermined lighted length.

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