Jan. 26, 1954 J. FLAWS, JR 2,667,189

METHOD AND APPARATUS FOR MOUNTING FILAMENT WIRE

Filed April 20, 1950

Fig. 1. Fig. 2. Fig. 3.

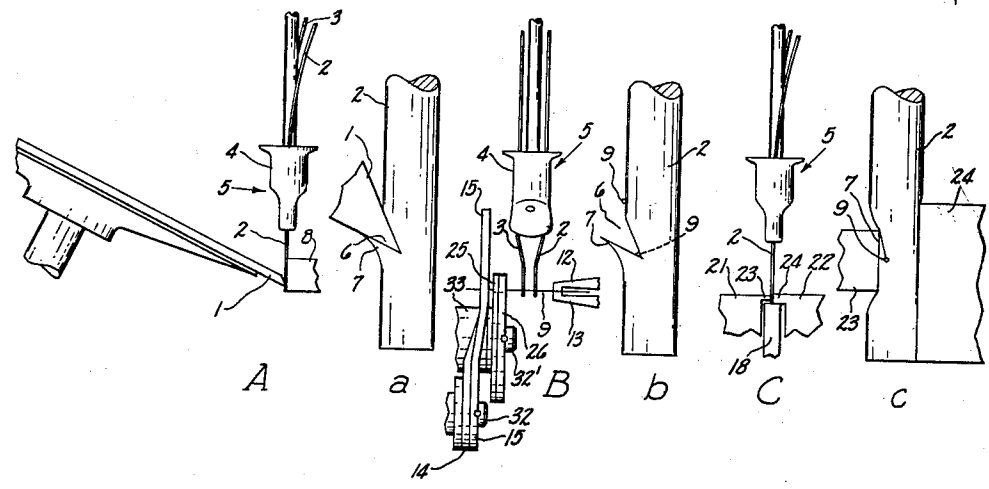
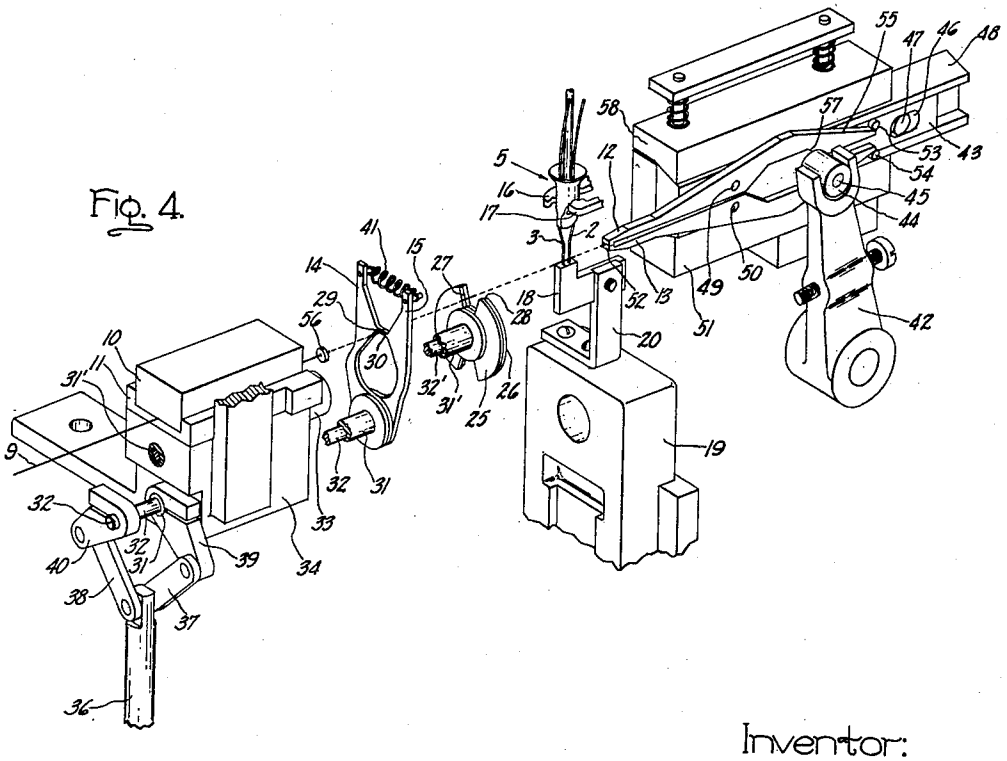


Fig. 4.



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Patented Jan. 26, 1954

2,667,189

UNITED STATES PATENT OFFICE

2,667,189

METHOD AND APPARATUS FOR MOUNTING FILAMENT WIRE

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Application April 20, 1950, Serial No. 157,050

7 Claims. (Cl. 140—71.6)

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My invention relates to the manufacture of photographic flash lamps, electric incandescent lamps and similarly constructed devices having a filamentary wire mounted between a pair of current-carrying conductors. My invention relates to a method and apparatus particularly adapted to automatic forms of operation wherein a filamentary wire is presented at mounting relation to a pair of conductors, for instance, the conductors extending from a vitreous stem and wherein said filament wire is attached to said conductors, for instance, by working portions thereof over the filament wire. The invention is of particular advantage in the mounting of a straight length of an extremely fine wire having little strength between juxtaposed end portions of a pair of conductors, thereby enabling use of the filament mount on low energy electrical circuits of both low current and low voltage.

My method and apparatus are an improvement of the general method and apparatus disclosed in my United States Patent 2,327,033 which issued August 17, 1943, and which is assigned to the assignee of the present invention.

One object of my invention is to provide an improved method and apparatus for the automatic mounting of an extremely fine wire on a pair of conductors, the method and apparatus being characterized by an ability to present a length of filament wire in mounting relation to the conductors and to attach said filament wire to said conductors in a satisfactory manner without injury to the filament wire.

The invention provides a method of arranging the filament at mounting relation to the conductors which eliminates the possibility of misalignment therebetween caused by inaccuracies of operation effected by normal variations in apparatus. The invention also affords a manner of attaching the filament to the conductors which obviates the many difficulties of making a low resistance connection to an extremely fine wire of relatively little strength.

Another object of my invention is to provide a method and apparatus capable of innumerable cycles of operation in a satisfactory manner without appreciable variation and without development of more than a moderate amount of wear in the apparatus. The invention has particular reference to the manner and means of arranging a filament wire at an accurate relation to conductors and of working portions of the conductors to cause them to grip the filament wire.

And still another object of my invention is to provide apparatus particularly adapted to effect the mounting of fine wire having sufficient

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springiness and curl to move by elastic reaction out of its lie in the usual mounting apparatus so as to interfere with the operation thereof. My apparatus provides means for withdrawing wire from a supply spool and attaching the withdrawn wire to a pair of conductors in successive cycles of operation without manual attention.

Generally speaking, my invention relates to a method and apparatus wherein a length of filamentary wire is first arranged adjacent to portions of a pair of conductors and is then advanced into hooks or below lips in the conductors by a relative motion therebetween in a direction parallel to the extent of said conductors. Also preferably included within the invention is means for advancing the filament wire from a main supply thereof and means for holding and for retaining control over the free end of the main supply developed in each cycle of operation so as to assure successive cycles of operation without rethreading said wire in said means.

Still other objects and features of the method and apparatus of my invention will appear in the detailed following description and in the drawing.

In the drawing, Fig. 1 is a composite side elevation showing a roll in the course of working notches and lips on conductors extending from a vitreous stem, view A being at slightly less than normal scale, and view "*a*" being at a greatly enlarged scale and showing only a portion of said roll and said conductors; Fig. 2 is a similar composite side elevation showing the stem and filamentary wire at the moment of arrangement of said filament wire at mounting relation to the conductors and showing the knives and the holding and feeding jaws for the filamentary wire, view B being at the reduced scale and at a right angle to Fig. 1, and view *b* being at the enlarged scale and at the same angle as Fig. 1 and showing only a portion of one conductor and the filamentary wire; Fig. 3 is a similar composite side elevation of the stem and filamentary wire at the moment said filament wire is secured to the conductors by the clamping jaws, views C and *c* being at the same angle as Fig. 1 and at the same scale as respective views thereof; and Fig. 4 is a perspective view of the essential means for advancing the filamentary wire to mounting relation to the conductors of the stem, the means being shown for clarity as spaced abnormally along the length of the wire.

For a complete understanding of the method and apparatus of the invention, reference is made to the accompanying drawing and the disclosure of my United States Patent 2,327,033, dated

August 17, 1943, which presents a complete showing of the general arrangement of mounting apparatus of the general character of the present apparatus in an automatically operated lamp-making machine. The mounting apparatus is arranged so that the first step of the method occurs at one work station when the roll 1 is caused to pass across lower end portions of two metal conductors 2 and 3 (views A and B of Figs. 1 and 2) extending from the lower end of the vitreous tube 4 comprising the stem 5. The sharp edge about the periphery of the roll forces corresponding grooves or notches 6 in the conductors 2 and 3 and develops corresponding projections or lips 7 overhanging said notches 6 and said conductors 2 and 3. A metal block 8 prevents the conductors 2 and 3 from being pushed aside by the roll 1 which is moved in a manner duplicating the operation of the roll in my Patent 2,327,033. The stem 5 is supported by movable means, not shown in the present disclosure but preferably a part of one of the heads of a conveyor as shown in the aforesaid patent which conveyor advances said stem 5 to a succession of work stations in turn and, accordingly, advances said stem 5 to operative relation to a mechanism of which the roll 1 and the block 8 are a part. However, the roll 1 in the illustration of the present invention has opposite faces of the edge at approximately 40 degrees to each other and at a mean angle of approximately 45 degrees to the vertical position of the conductors 2 and 3 and, accordingly, forces metal from said conductors 2 and 3 so as to form lips 7 projecting laterally therefrom. The roll 1 shown is caused to penetrate conductors 2 and 3 (of a diameter of .020 inch) to a depth of .007 inch and in so doing develops notches 6 having a .005 inch width along the face of said conductors 2 and 3.

The succeeding operations of the method occur at a work station separated from the notching means and to which the stem 5 is advanced in turn by its support means. At this succeeding work station, apparatus is provided for holding a filament wire 9 at mounting relation to the conductors 2 and 3. The filament wire 9 is held across the conductors 2 and 3 while it is still connected to the main supply and while it is stretched taut between the friction blocks 10 and 11 and the wire-feeding jaws 12 and 13 so as to lie in a straight line as illustrated diagrammatically in Fig. 4. A pair of wire-holding jaws 14 and 15 also grip an intermediate section of the end portion of the filament wire 9 and assist in fixing the position thereof. The friction blocks 10 and 11, the wire-holding jaws 14 and 15 and the wire-feeding jaws 12 and 13 are arranged in the present instance at an elevation to position the filament wire 9 against portions of the conductors 2 and 3 spaced from the overhanging lips 7 in the manner shown at B and *b* in Fig. 2. Some variations can exist in the elevation taken by the stem 5 at this work station because the stem-supporting conveyor-heads, herein represented only by the jaws 16 and 17, are not capable of being positioned with the desired accuracy; and, accordingly, the exact position taken by the filament wire 9 along the wires 2 and 3 is not the same in succeeding cycles of operation. It has been established, in one instance, that if the apparatus is adjusted to place the filament wire 9 normally .020 inch above the lips 7 under normal conditions, said filament 9 will always contact the conductors 2 and 3 at a position above said lips 7 and satisfactory operation can be expected under all normal conditions.

The next step in the cycle of operation occurs when the anvil 18 is moved up against the lower ends of the conductors 2 and 3 and pushes the stem 5 and said leads 2 and 3 upward sufficiently to cause the filament wire 9 to, in effect, slide into and finally rest at the base of the notches 6 as shown in dotted lines in *b*, Fig. 2. The upward motion of the anvil 18 slides the stem tube 4 upward through the jaws 16 and 17 and moves the conductors 2 and 3 sufficiently to carry the filament wire 9 completely to the base of the notches 6 under all conditions and variations usually encountered and usually causes the conductors 2 and 3 to pull said filament wire 9 upward from its normal straight lie opposite the ends of the wire-feeding jaws 12 and 13. Any slight increase in tension created in the filament wire 9 does not result in injury thereto even though said wire 9 is often .0007 inch or less in diameter. The apparatus for effecting movement of the anvil 18 is the positioning slide 19 of clamping means providing for the forcing of the lips 7 down against the filament wire 9 and the conductors 2 and 3 in the manner disclosed at C and *c*, Fig. 3. The anvil 18 is mounted at a fixed height above the slide 19 on the bracket 20 extending from the top surface thereof and takes the controlled upward motion thereof occurring in the first part of the next function of the apparatus.

After the filament wire 9 is located at the base of the notches 6 in the conductors 2 and 3, the lips 7 are bent over onto the filament wire 9 by the closing action of two clamping blocks 21 and 22 (C, Fig. 3) which move in against both conductors 2 and 3 from opposite sides. The motion of clamping blocks 21 and 22 correspond to that of similar means disclosed in my prior Patent 2,327,033 and is preferably created by mounting said clamping blocks 21 and 22 upon jaws pivoted upon the vertically movable positioning slide 19 in the manner of the means in said patent. The conductors 2 and 3 are engaged by projecting portions 23 and 24 of the clamping blocks 21 and 22, respectively, which portions have flat end surfaces not easily deformed in the course of the operation of the apparatus and which are, accordingly, capable of operating in a uniform manner for extended periods of time. The flat end surfaces of the projecting end portions 23 and 24 of the clamping blocks 21 and 22 effect a slight reduction in the thickness of the conductors 2 and 3 and press the lips 7 tightly against the main body thereof with sufficient force to make a tight and secure connection to the filament wire 9. The manner of connecting the conductors 2 and 3 and filament wire 9 together is such as to avoid possible injury to the filament wire 9 and to provide uniformly low resistance connections therebetween. The apparatus can therefore be used to mount the smaller size filament wires .0007 inch or less in diameter and make mounts suitable for use on very low volt and low current circuits. Withdrawal of the clamping blocks 21 and 22 and the anvil 18 occurs immediately after the closing movement of said clamping blocks.

The final step in the manufacture of the mount occurs when the circular knives 25 and 26, which are located adjacent conductor 3, are rotated so as to cause the coacting edges 27 and 28 to close on the filament wire 9 and cut it. This operation separates that portion of the filament wire

connected to the conductors 2 and 3 from the main supply thereof and in so doing develops a new end on said supply opposite the knives 25 and 26. Inasmuch as the wire-feeding jaws 12 and 13 and the knives 25 and 26 are spaced from the conductors 2 and 3, a considerable excess of the filament wire 9 is attached thereto, which excess appears in an end extending from conductor 3 to the cutting edges 27 and 28 of the circular knives 25 and 26 and another end extending from conductor 2 to the wire-feeding jaws 12 and 13, as shown at B, Fig. 2. At the conclusion of the cutting operation, the wire-feeding jaws 12 and 13 are opened to release the filament wire 9 attached to the conductors 2 and 3 from all contact with the apparatus. The operation of mounting the filament wire 9 is now complete and the mount held by stem 5 has only to be removed to complete the cycle of operation.

The filament wire 9 which has been mounted upon the stem 5 in the course of the above-described operations actually starts through its cycle of operation prior to the moment when the knives 25 and 26 are operated, at which time the cooperating faces 29 and 30 of the holding jaws 14 and 15 close upon that portion of the filament wire 9 which becomes the free end thereof after operation of said knives 25 and 26. The function of the wire-holding jaws 14 and 15 is to prevent the newly created end of the filament wire 9, which is relatively springy, from curling outward from its normal lie so that said end can be readily picked up and fed in the immediate operating interval of the apparatus. The wire-holding jaws 14 and 15 are arranged to turn about a common axis through the center of the hollow shaft 31 and the solid shaft 32 which are the respective supports for said holding jaws 14 and 15 and are shaped so as to extend around the boss 33 on the end surface of bracket 34 which boss 33 holds the corresponding hollow and solid support shafts 31' and 32' for the knives 25 and 26. The shafts 31 and 32 extend through the full width of the bracket 34 and provide for the operation of the wire-holding jaws 14 and 15 in much the same manner as the shafts 31' and 32' provide for the operation of the knives 25 and 26. Vertical movements of a rod 36 connected to the shafts 31 and 32 through the links 37 and 38 and the arms 39 and 40 provide the means of operating the holding jaws 14 and 15 at the proper moments from a central controlling means (not shown). At the presently referred to moment, the wire-holding jaws 14 and 15 are held in a closed position by the helical spring 41 extending between spring posts in the upper end of both jaws.

The operation of advancing the filament wire 9 to mounting relation in the apparatus is effected by the wire-feeding jaws 12 and 13 which are shifted from the position shown to a gripping relation to the end portion of the filament 9 by a counterclockwise (Fig. 4) movement of the operating arm 42. The movement of the arm 42 is transferred to the sub-slide 43 through engagement with the roller 44 on pin 45 projecting from the side thereof and advances said jaws 12 and 13 when the base of the slot 46 in said sub-slide 43 engages the stud 47 and advances the main slide 48. The jaws 12 and 13 are pivoted upon the pins 49 and 50 projecting from the forward end portion of the main slide 48 which is located within ways in the bracket 51 and at the moment of advance are spaced apart at their forward nib ends 52 by the pressure of two studs 53 and 54 against their angular back portions 55 so that

said nib ends 52 pass above and below the cooperating wire-gripping faces 29 and 30 of the wire-holding jaws 14 and 15. The nib ends 52 of the wire-feeding jaws 12 and 13 advance to positions between the holding jaws 14 and 15 and a fixed guide 56 adjacent the friction blocks 10 and 11 and then close upon said wire 9 under the influence of a return clockwise movement of the operating arm 42 which shifts the subslide 43 with respect to the main slide 48 sufficiently to carry the studs 53 and 54 beyond the back portions 55 of said jaws 12 and 13 and a portion of pin 45 into a wedging position against corresponding angular inner faces 57 (only one face partially shown) of said jaws 12 and 13. Longitudinal movement does not occur in the jaws 12 and 13 at that particular moment as the limited movement of the operating arm 42 is only sufficient to reposition the subslide 43 within the main slide 48. Friction produced by the spring pressed gib 58 against the top edge of the main slide 48 holds it and the feeding jaws 12 and 13 in place at such times. Now that the end portion of the filament wire 9 is held by the wire-feeding jaws 12 and 13, the holding jaws 14 and 15 are opened by an upward movement of the operating rod 36 which transfers motion to the support shafts 31 and 32 therefor through actuation of the links 37 and 38 and the arms 39 and 40. Said wire-feeding jaws 12 and 13 are then caused to move to the right (Fig. 4) to the position shown. The operation means for the rod 36 corresponds to similar means for actuating the knives 25 and 26 and many other actuating means common to lamp-making apparatus which means afford timed and otherwise controlled actuation of the various elements thereof. The movement of wire-feeding jaws 12 and 13 pulls additional filament wire 9 from the main supply thereof (not shown) and advances it between the friction blocks 10 and 11, through the guide 56, between the open holding jaws 14 and 15, through the open notch in the circular knives 25 and 26 and finally to a position opposite that taken by the conductors 2 and 3, the position shown in Fig. 4. The actual relation of the feeding jaws 12 and 13 to the knives 25 and 26 and the holding jaws 14 and 15, which are closed immediately after the wire 9 is advanced, appears as shown at B in Fig. 2 in the instance described when the wire-feeding operation is complete. These feeding and jaw-closing operations are the final operations in the cycle performed by the described apparatus, a cycle of which is repeated each time a stem is advanced into operative relation thereto.

Although a preferred embodiment of the invention has been disclosed, it will be understood that the invention is not to be limited to the specific construction of the parts shown but that said parts can be modified within the spirit and scope of the invention as defined by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of mounting a filament wire upon spaced metal conductors each conductor having a laterally projecting lip, which comprises first arranging spaced portions of the filament wire in contact with portions of the conductors adjacent to but spaced slightly from the projecting lips thereof, then effecting a relative movement of the conductors and the filament wire to slide said portions of said filament wire along the conductors to positions behind the lips, and clamping the lips tightly against the filament

wire portions and the adjacent conductor portions to cause the filament wire to be attached to said conductors.

2. The method of mounting a filament wire upon spaced metal conductors extending from a stem which comprises working each conductor to develop a diagonal notch with a protruding lip at one edge thereof, advancing spaced portions of the filament wire to contact with portions of the conductors on the opposite side of the notches from the lips, then effecting a relative movement of the stem and the filament wire to slide said portions of the filament wire along the conductors and into the notches therein, and clamping the lips over the filament wire portions to close the notches in the conductors and cause the filament wire to be attached thereto.

3. Apparatus for mounting a filament wire upon spaced metal conductors, each conductor having a lip projecting laterally from the side thereof, comprising wire-holding jaws adapted to periodically grip and thereby position the end portion of the filament wire, cutting means located adjacent the wire-holding jaws and the end of the filament wire, lead-supporting means located adjacent the cutting means and beyond the end of the filament wire, movable wire-feeding jaws mounted in a plane normal to the plane of said wire-holding jaws and adapted to grip the end portion of the filament wire on the opposite side of the holding jaws from the cutting means and to advance it longitudinally between said holding jaws and beyond said cutting means in position for engagement with portions of the conductors adjacent the lips, means for moving said wire-feeding jaws as aforesaid, means for effecting a relative movement in the conductors and the feeding jaws to cause the filament wire to slide along the conductors to positions below the lips, clamping means located adjacent the conductor-supporting means for pressing the lips tightly against the filament wire and the conductors to cause said filament wire to be attached thereto, and means for actuating the cutting means and opening the feeding jaws to release the filament wire attached to the conductors from the apparatus.

4. Apparatus for mounting a filament wire upon spaced metal conductors extending from a stem, each conductor having a lip projecting laterally from the side thereof, comprising wire-holding jaws adapted to periodically grip and thereby position the end portion of the filament wire, cutting means located adjacent the wire-holding jaws and the end of the filament wire, stem-supporting means located adjacent the cutting means and beyond the end of the filament wire, movable wire-feeding jaws mounted in a plane normal to the plane of said wire-holding jaws and adapted to grip the end portion of the filament wire on the opposite side of the holding jaws from the cutting means and to advance it longitudinally between said holding jaws and beyond said cutting means in position for engagement with portions of the conductors adjacent the lips, means for moving said wire-feeding jaws as aforesaid, movable means for effecting movement of the stem in the support means to cause the filament wire to slide along the conductors to positions below the lips, clamping means located adjacent the conductor-supporting means for pressing the lips tightly against the filament wire and the conductors to cause said filament wire to be attached thereto, and means for actuating the cutting means and opening the feeding jaws to release the filament wire attached to the conductors from the apparatus.

5. The method of securing a filament to a pair of spaced, generally parallel lead-in conductors which comprises forming, in corresponding sides of said conductors, projections extending laterally from the conductors and laterally of the plane including said conductors, holding taut a length of filament wire by gripping it at points spaced apart a distance greater than the spacing of said conductors, bringing said filament and conductors into firm engagement and with the filament extending across the said corresponding sides of the conductors at points therealong spaced slightly away from the said projections and then effecting a relative movement of said filament and conductors in a direction to cause the filament to slide along the conductors and into firm engagement with the said projections, and finally pressing said projections against the main body of the conductors to clamp the filament thereto.

6. Apparatus for securing a filament to a pair of spaced, generally parallel lead-in conductors extending from a stem and having projections extending laterally from corresponding sides thereof and laterally of the plane including said conductors and comprising, gripping means constructed and arranged to grip a length of filament at points spaced apart a distance greater than the spacing of said conductors, support means to support said stem, means mounting said gripping means and said holder means for relative movement in a direction to bring said filament and conductors into firm engagement and with the filament extending across the said corresponding sides of the conductors at points therealong spaced slightly away from said projections, means for effecting the said relative movement of said gripping means and holder means, means operable subsequent to the said relative movement of said gripping means and holder means to effect relative movement of said conductors and filament in a direction to cause the filament to slide along the conductors and into firm engagement with the said projections, and means operable to clamp said projections against the main body of the conductors to secure the filament thereto.

7. Apparatus for securing a filament to a pair of spaced, generally parallel lead-in conductors extending from a stem and having projections extending laterally from corresponding sides thereof and laterally of the plane including said conductors and comprising, gripping means constructed and arranged to grip a length of filament at points spaced apart a distance greater than the spacing of said conductors, support means to support said stem, means mounting said gripping means and said holder means for relative movement in a direction to bring said filament and conductors into firm engagement and with the filament extending across the said corresponding sides of the conductors at points therealong spaced slightly away from said projections, means for effecting the said relative movement of said gripping means and holder means, means operable subsequent to the said relative movement of said gripping means and holder means to effect longitudinal relative movement of said conductors in a direction to cause the filament to slide along the conductors and into firm engagement with the said projections, and means operable to clamp said projec-

tions against the main body of the conductors to secure the filament thereto.

JOHN FLAWS, JR.

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