

Oct. 25, 1955

E. L. MIDGLEY ET AL

2,721,373

AUTOMATIC LEAD WIRE THREADING APPARATUS

Filed Nov. 17, 1948

7 Sheets-Sheet 1

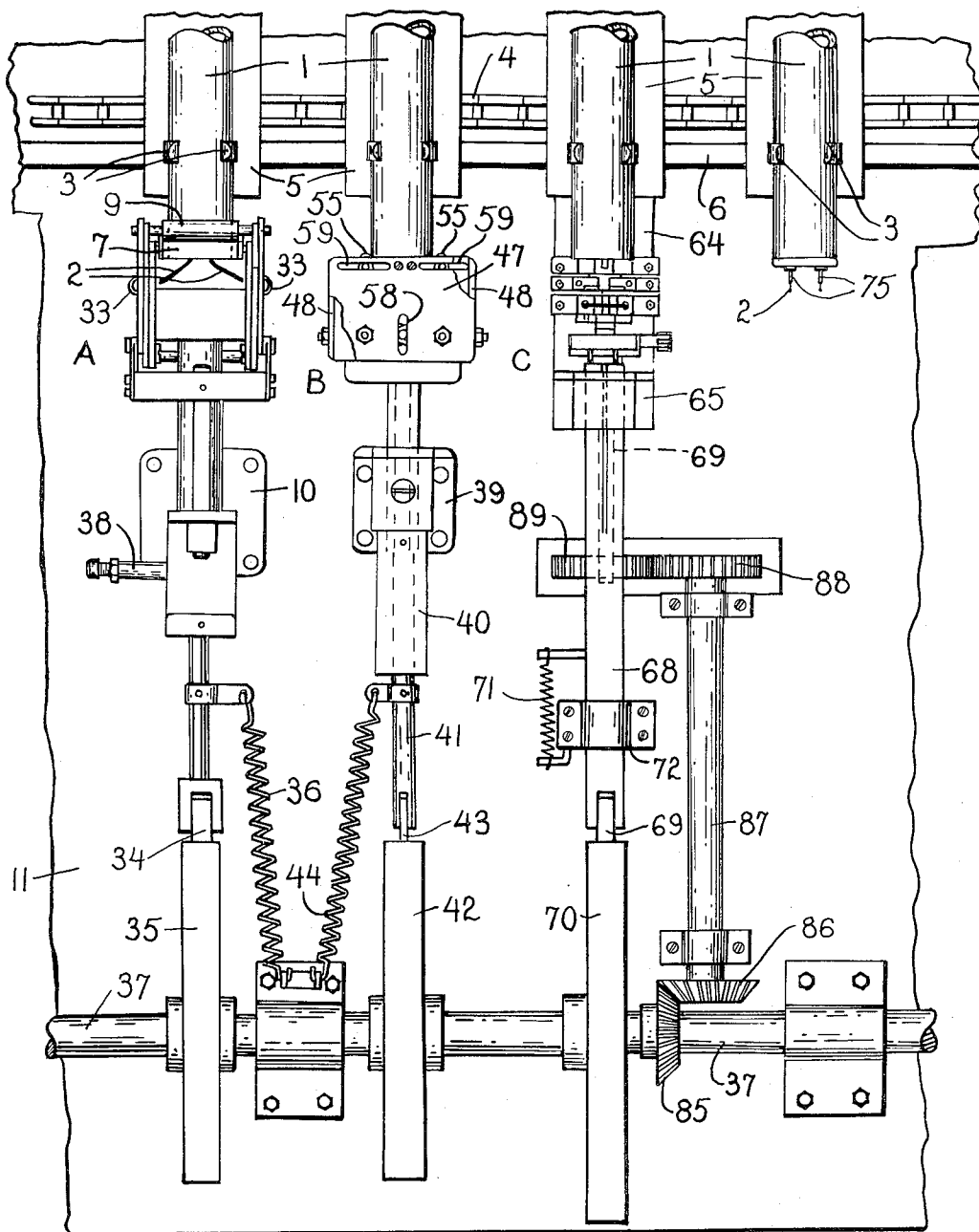


Fig. 1

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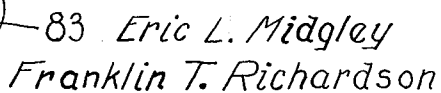
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7 Sheets-Sheet 2



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Fig. 2

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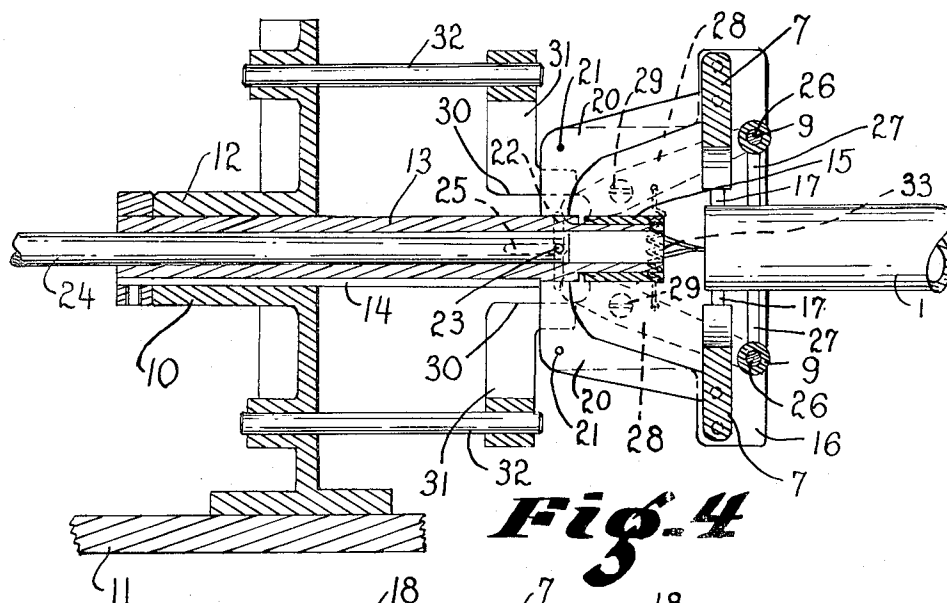


Fig. 4

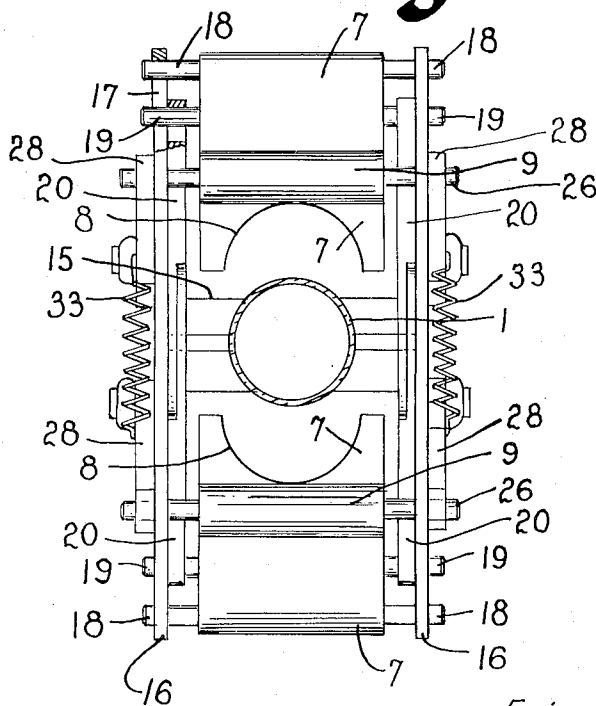


Fig. 5

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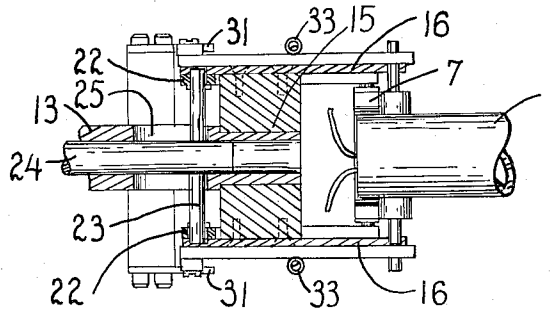


Fig. 6

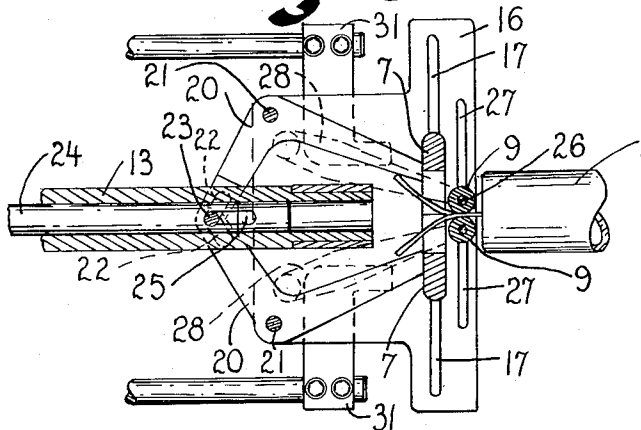


Fig. 7

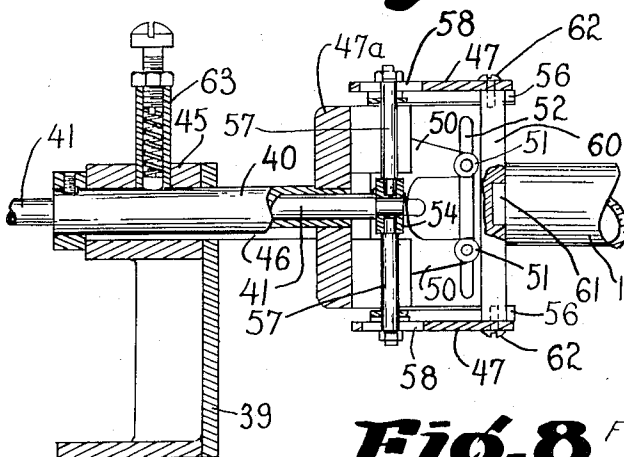


Fig. 8

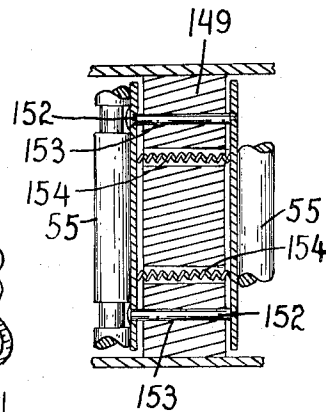


Fig. 6a

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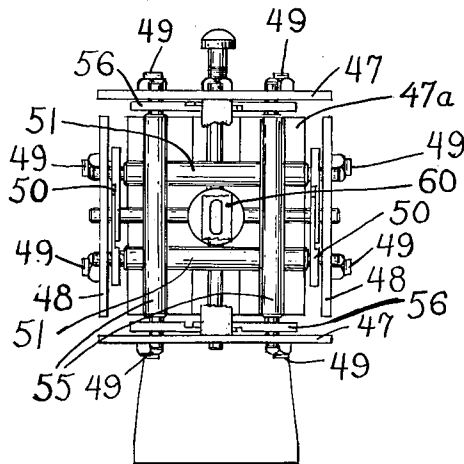


Fig. 9

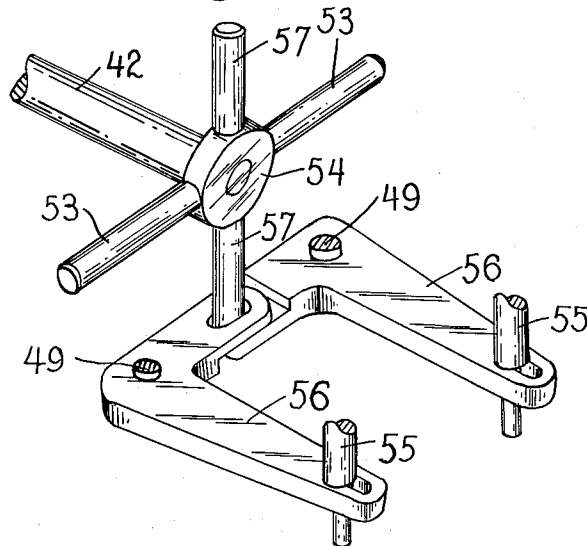


Fig. 10

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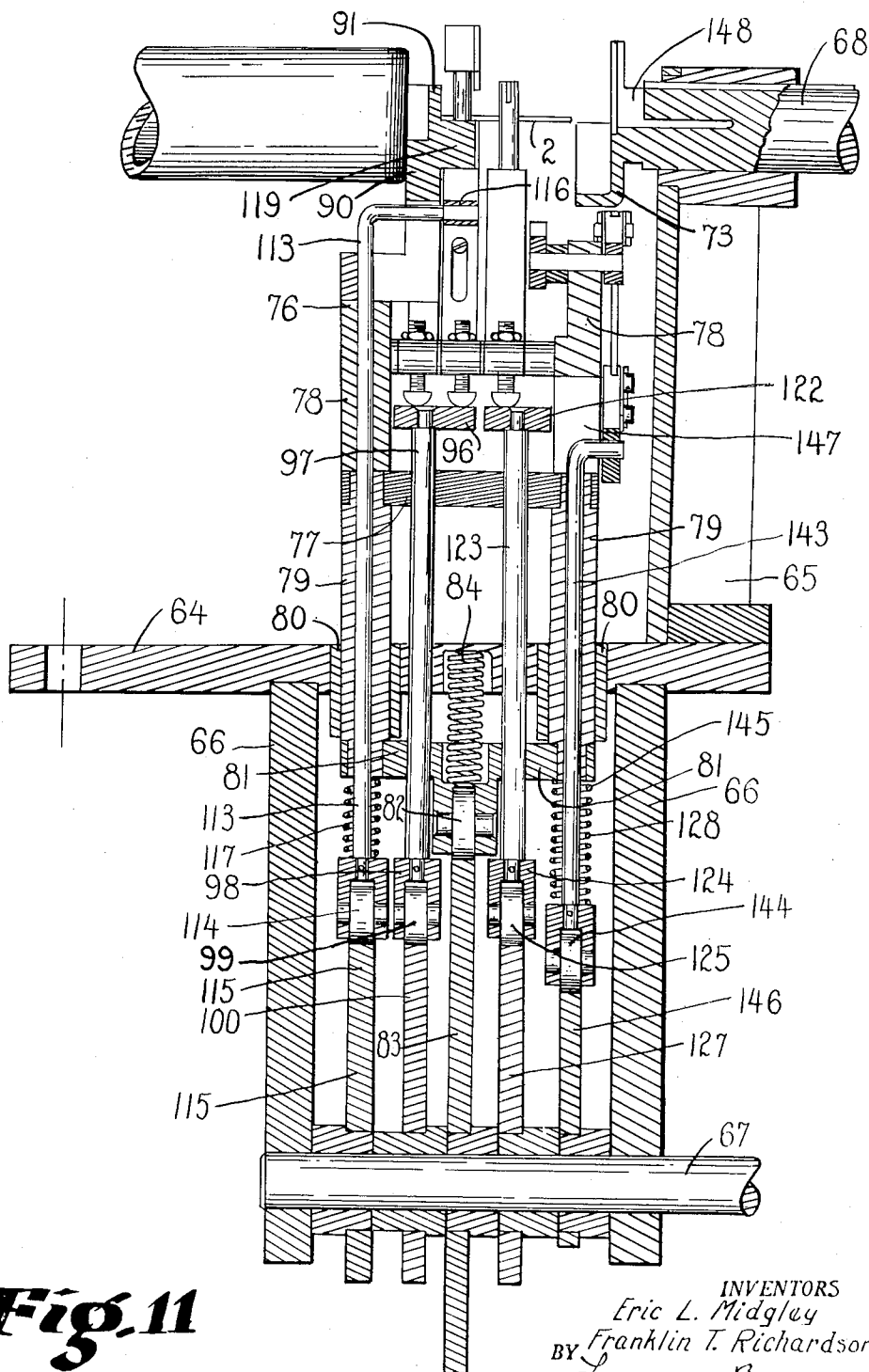


Fig. 11

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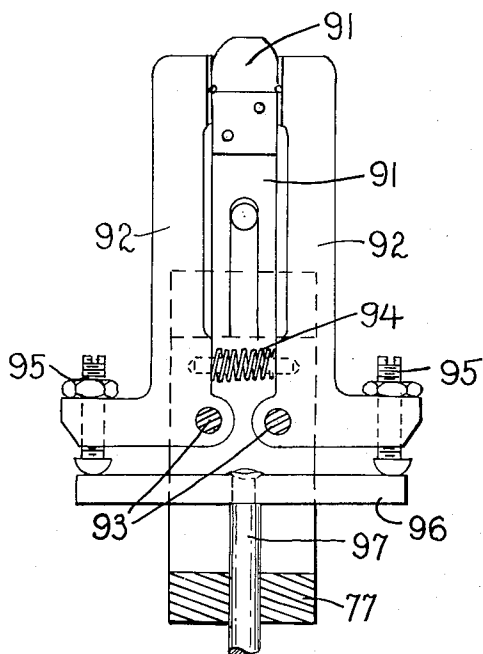


Fig. 12

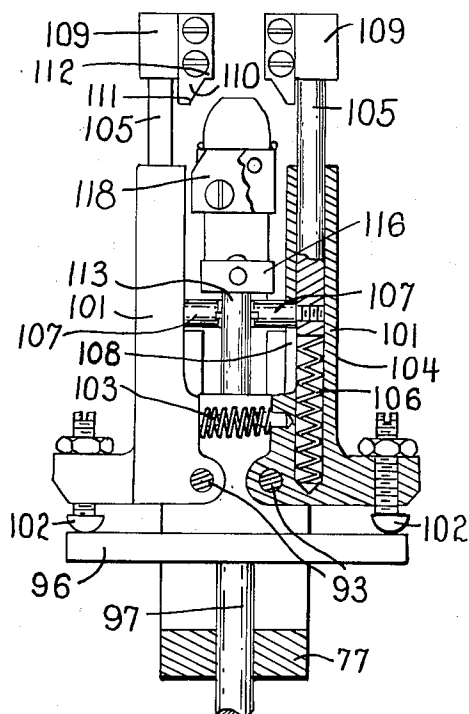


Fig. 13

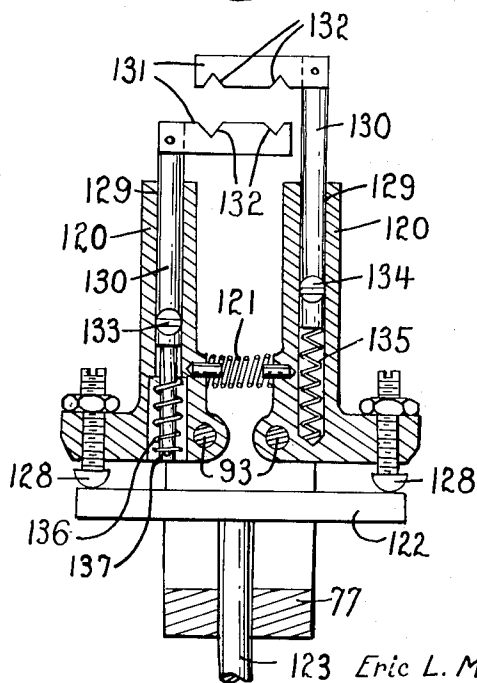


Fig. 14

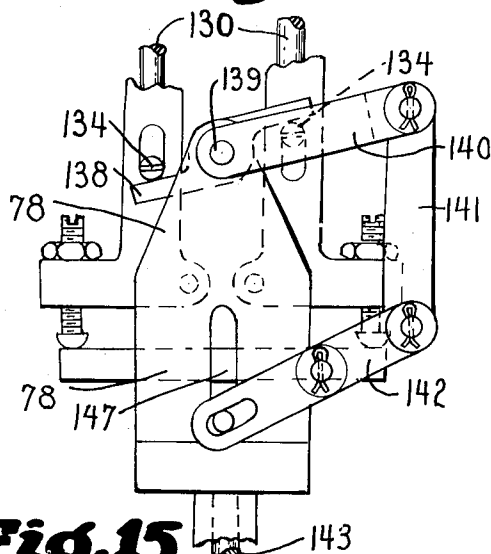


Fig. 15

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2,721,373

AUTOMATIC LEAD WIRE THREADING APPARATUS

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Application November 17, 1948, Serial No. 60,548

2 Claims. (Cl. 29—25.19)

This invention relates to automatic machines for straightening lead wires and particularly to such machines operable to accurately position the wires for threading into apertures in coating device such as a base member. The invention applies particularly to the manufacture of certain electrical devices such as lamps, radio tubes and discharge devices wherein their main elements are enclosed in evacuated envelopes and the elements themselves are provided with leads sealed through the base of the elements and before such leads are connected to contact pins or the like.

In such devices it is usual to provide a member of insulating material usually called a base having hollow contacting pins secured therein. These pins serve as connections to an external circuit when inserted in a socket or holding device. Prior to the mechanical attachment of the base to its envelope the lead wires are threaded through the pins. This latter operation is critical and requires skilled operators for its execution.

Upon completion of the electric device and before its base is secured thereto its lead wires are bent and generally disposed in a more or less random fashion. In some cases they are actually bent out of their normal operating position at this time to facilitate testing or other procedures. The present invention automatically straightens and arranges the wires in accurate position whereby the wires may be threaded into the pins by a simple movement of the base on the device along the axis of the wires.

For purposes of description the apparatus presented herein is adapted for threading the lead wires of a fluorescent lamp into its end caps or bases.

The invention includes means capable of reaching and partially aligning lead wires disposed in widely dispersed positions. The lamp is then moved to a second mechanism where the leads are straightened and positioned approximately upon their required threading positions in register with the openings in the base pins. The lamp is then moved to a third station where the wires are finally and accurately clamped in correct position by a plurality of clamps arranged to properly orient the wires and precisely position their outer ends in threading position after which the wires are threaded into the base by axial movement of a base holding member which is properly positioned to present the hollow pins of the base to pass over the ends of the lead wires.

An object of the invention is to provide an automatic mechanism for rapidly threading lead wires into the hollow pins of the bases of electrical devices having an exhausted envelope such as a lamp, vacuum tube or similar device.

A further object of the invention is to provide a lead wire threading mechanism which operates with positive reliability.

A further object of the invention is to provide an apparatus of the type indicated which possesses maximum rigidity and durability.

A further object of the invention is to provide a mechanism

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of the character set forth having consistently a high degree of accuracy.

A further object of the invention is to provide a wire threading device having combined wire straightening and positioning means to effect accurate orientation of the wires.

A further object of the invention is to provide a lead wire threading mechanism which includes a succession of manipulating means so arranged that the wires are positively and accurately brought to a predetermined position and linearity from positions of extreme misalignment.

Other objects and features of the invention will appear more fully from the following specification and will be particularly pointed out in the claims.

To provide a better understanding of the invention a particular embodiment thereof will now be described and illustrated in the accompanying drawings in which:

Fig. 1 is a plan view of the apparatus embodying the invention.

Fig. 2 is a perspective view of the portion of the apparatus for performing the final wire threading operations.

Fig. 3 is a perspective view of a lamp base which is applied to a lamp by the apparatus.

Figs. 4 and 5 are respectively a longitudinal and front view of the portion of the apparatus for initiating the wire straightening operation.

Fig. 6 is a partial horizontal sectional view of the mechanism shown in Figs. 4 and 5.

Fig. 6-A illustrates a modification of the anvil member shown in Figs. 8 and 9.

Figs. 7 and 8 are respectively horizontal and vertical sectional views of the portion of the apparatus for further and more accurately positioning and straightening the wires.

Fig. 9 is a front elevation of the mechanism shown in Figs. 7 and 8.

Fig. 10 is a perspective detail view of a portion of the roll actuating elements of the mechanism of Fig. 9.

Fig. 11 is a longitudinal sectional view of the portion of the apparatus for performing the final operations on the wires and threading them in the lamp base pins.

Figs. 12, 13, 14 and 15 are detail views of portions of the mechanism shown in Fig. 11.

The invention is described herein in connection with the mounting of bases upon the ends of fluorescent lamps. The invention may however be applied to a wide variety of electrical devices.

When the lamps 1 are completed to the point where their bases are to be applied their lead wires 2 are disposed in a more or less random manner. In some methods of lamp manufacture the lead wires are bent outward at right angles to the lamp axis to make contact with a power source to test the lamp filaments or for any other desired purpose.

Any mechanism therefore which undertakes to straighten and align the wires must be capable of straightening and positioning the lead wires in proper threading position from any extreme position of misalignment.

The lamps with their projecting lead wires are placed in the holding clips 3 of the conveyor 4. The conveyor may be of any suitable construction. As shown herein it is provided with spaced holder elements 5 upon which the clips 3 are mounted. The holders 5 are supported upon and move along a guideway 6. It is considered necessary to show only one side of the conveyor since both sides are identical. Moreover a duplicate mechanism may be provided to simultaneously process the other ends of the lamps. The lamps are placed in their holders with the points at which their lead wires are sealed into their envelopes disposed in predetermined relation to the threading mechanism.

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In the embodiment of the invention described herein the sealing in position of the two leads is placed upon a horizontal plane.

The lamps are presented successively to three portions of the apparatus to be called stations A, B and C to perform the threading operation.

The lamps are first presented to station A where the conveyor stops with the lamp axis in line with the working axis of the mechanism of this station. The station has two pairs of wire manipulating elements. One pair 7 have the form of vertically moveable blocks in the opposing edges of which is formed a semicircular recess 8 having a radius slightly larger than that of the lamp. While the other pair of manipulators are in the form of interengaging rolls 9.

The mechanism for operating these manipulators is mounted upon and moveable in a supporting member 10 which in turn is fixed to a frame or supporting surface 11 common to all the elements of the apparatus.

The support 10 has a hub portion 12 within which is slidably received a support shaft 13 having a spline 14 to maintain the shaft and its elements in predetermined alignment. The end of the shaft 13 adjacent the lamp has secured thereto a flat sided head 15 to the vertical faces of which are secured supporting plates 16. The plates 16 have formed therein oppositely disposed slots 17 at their upper and lower portions within which are received two pairs of pins for each of the manipulators 7. The pins 18 being toward the outer end of the slot and the pins 19 being toward the inner ends of the slots. The pins are properly fitted to the slots to guide the manipulators in vertical planes.

The manipulators are actuated by pairs of bell crank levers 20 which are pivoted at 21 upon the plates 16. One arm of the levers is connected to the pins 19 on the members 7 while the other arms thereof extend inward and are provided with vertical slots 22 into which extend a pin 23. The pin 23 is secured in a rod 24 axially moveable in the shaft 13. To provide for movement of the rod and pin 23 slots 25 are formed in the shaft 13.

The manipulator rolls 9 are rotatably mounted upon shafts 26 which extend through slots 27 in the plates 16 and through the ends of levers 28. The levers 28 are pivoted upon the plates 16 at 29. The other ends of the levers 28 are provided with rolls which engage the edge 30 of the cam members 31 which are in turn supported upon rods 32 which are rigidly anchored in the support 10. Four such levers are provided two for each roll 9. Engagement of the rolls on the levers with the cam members maintain the rolls 9 separated as shown in Fig. 4 against the action of springs 33 connected between the levers.

The rod 24 is extended and provided with a cam roll 34 which is held upon the periphery of a cam 35 by a spring 36. The cam 35 is mounted upon and rotated by a shaft 37. The shaft is driven by any suitable sources of power not shown.

The position of the elements at station A shown in Fig. 1 occurs shortly after the lamp has been moved into position on the center line of the station by the conveyor, after which the cam 35 acts to move the shaft 13 and manipulator mechanism inward to the position shown in Fig. 4. At this time the members 7 embrace the end of the lamp.

The cam now acts to retract the rod 24 to the left. During the first part of its motion the shaft 13 is held against movement by a friction device 38 acting on the surface of the shaft. The motion of the rod therefore acts through the pin 23 and the levers 20 to move the manipulators 7 into closed position embracing the lamp.

When the pin 23 reaches the left hand end of the slots 25 the shaft 13 starts to move with the rod 24. The manipulators 7 engage and partly align the wires and when the rolls 9 reach a position beyond the end of the lamp the rolls on the ends of the levers 28 ride off the end of

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the cam faces 30 which allow the springs 33 to move the rolls 9 into contact. The parts are now in the position shown in Fig. 6. Continued movement of the cam 35 moves the mechanism toward the left thus rolling the wires to an approximately straight condition in a horizontal plane.

When the rolls have passed beyond the ends of the wires the lamp is moved to station B where the wires are further straightened and located closer to their intended disposition. The mechanism at this station is supported upon a standard 39 secured to the base member 11. This station is operated by horizontal movements of a shaft 40 and an inner rod 41 in a manner similar to station A. Such movement is derived from the cam 42 mounted upon the common drive shaft 37. The cam transmits motion to the rod 41 by means of a roll 43 held against the cam by a spring 44. The shaft 40 is held against rotation in the hub portion 45 of the stand 39 by a spline 46 secured in the shaft 40.

The mechanism of this station is mounted upon a block or crosshead 47a which is rigidly secured to the end of shaft 40. The crosshead has secured thereto top and bottom guide plates 47 and a pair of side guide plates 48. A convenient means for securing these plates is to bolt them to studs 49 which are anchored in the crosshead. These studs are so made that the plates 47 and 48 are spaced from the sides of the crosshead. The portion of the studs between the crosshead and the plates serve as journals or fulcrum points for pairs of bell crank levers 50 at the side of the crosshead.

The outer ends of these levers have pivoted therein a pair of horizontal rolls 51. The shafts upon which the rolls rotate are extended and move in slots 52 in the side plates 48 to cause the rolls to move in the flat plane. The other ends of adjacent levers 50 overlap and have short vertical registering slots into which extend horizontal actuator rods 53. The rods are secured in a head 54 secured upon the end of the rod 41.

Another pair of rolls 55 are vertically mounted in the mechanism in a manner similar to the horizontal rolls 51. The rolls 55 are rotatably mounted in short slots in the outer ends of two pairs of bell crank levers 56 pivoted upon the studs which secure the bottom and top plates 47. The inner ends of the levers overlap and are provided with short overlying slots through which extend the outer ends of actuator rods 57. The rods extend through the levers and into slots 58 in the plates 47 and are fixed at their inner ends in the head 54.

The pivot shafts for the rolls 55 project into slots 59 in the plates 47 to stabilize the rolls and confine their movement to a flat plane.

When the present invention is used in the manufacture of lamps the lead wires must be spaced a predetermined distance and be parallel in order to be properly threaded into the hollow pins in their bases. To space the wires, a centrally disposed vertical anvil member 60 having flat sides is secured at its top and bottom ends in the plates 47. Desirably the anvil is made interchangeable to provide for inserting anvils of different widths or shapes to provide for different sizes of lamps or other types of electrical devices. It is desirable also that a recess 61 be provided in the anvil to receive an exhaust tube or other projection on the lamp or other device when the device approaches close to the anvil. The anvil may be removably secured in place by means of screws 62.

In operation the cam 42 acts to withdraw the mechanism of station B while the lamp with its partially straightened lead wires is moved into position to be operated on at station B. The cam 42 now moves the mechanism inward to a point where the plane of the rolls is spaced a short distance from the end plane of the lamp. At this time the lead wires will have passed between each of the rolls 55 and the anvil 60 and between the separated rolls 51.

The cam now retracts the rod 42 to the left while the

shaft 41 is held against movement by the friction device 63. The movement of the shaft 42 causes rolls 55 to clamp the lead wires 2 against the sides of the anvil and the rolls 51 come together to clamp the wires at another point. The cam 42 now retracts the mechanism causing both pairs of rolls to straighten and position the wires in their predetermined spaced relationship.

The lamp is now transferred to station C where the leads 2 are finally positioned and held for threading of the bases thereon and the base is moved into its operating position. The mechanism of station C is mounted on a special frame having a base 64 upon which is secured an upstanding bracket 65 and a pair of depending bearing post 66 within which is journaled the cam shaft 67 for operating the mechanism. Desirably the base 64 is secured to the general support 11 with the posts 66 projecting downward through an aperture in the support.

The bracket 65 has slidably mounted therein a horizontal shaft 68 splined to the aperture in which it slides. The axis of the shaft 68 is in line with the axis of the lamp as are the center lines of the various elements which perform the function of station C. The outer end of the shaft 68 is provided with a roll 69 which engages a cam 70 mounted on the shaft 37. The roll is held against the cam by means of a spring 71. The outer portion of the shaft is slidably supported in a post 72 secured to the base member 11. The inner end of the shaft 68 has secured thereon a holder 73 for a lamp base 74 having hollow conductor pins 75.

The portion of the mechanism which straightens and positions the lead wires is mounted upon a vertically movable frame or carriage 76 having a base 77 which is provided with uprights 78 at its ends. The carriage 77 is supported upon a pair of vertical rods 79 which are rigidly anchored in the base 77 and extend downward through suitable bushings 80 in the base member 64. The lower ends of the members are rigidly secured in a crosshead 81. The crosshead is provided with the central downward extension within which is received a roll 82 engaging a cam 83 secured upon the shaft 67. The roll 82 is held upon the cam by a spring 84 between the base 64 and the crosshead 81.

The shaft 67 is rotated in any suitable manner. It may conveniently be driven from the main cam shaft 37. To do this a bevel gear 85 is secured to the shaft 37 and has a meshing gear 86 mounted on an auxiliary shaft 87 journaled in bearings secured to the support 11. The other end of this shaft has secured thereon a gear 88 which meshes with a suitable gear train, not shown, to drive a gear 89 secured upon the shaft 67. The speed ratios of the gears are chosen to provide a one to one drive between shafts 37 and 67. The cam 83 is designed to produce the desired rise and fall of the carriage 76.

The conveyor 4 moves the lamp into its correct position at station C. At this time the carriage has been moved down out of operating position to permit the lead wires to move into position for their final processing. The operating elements of the carriage at this time, are swung laterally outward as will be described hereinafter. The carriage is now moved up into operating position as shown in Figs. 2 and 11.

At this station the lead wires are engaged at three points along their length. Closely adjacent the end of the lamp the wires are clamped in their spaced relationship. To do this a central anvil member 90 secured to the adjacent upright 78 has an upstanding portion 91 which passes between the wires when the carriage is raised to operating position. The sides of the member 91 are flat and are engaged by clamps or hammer members 92 which are generally L-shaped and pivoted upon parallel fulcrum shafts 93 secured in the uprights 78. An expansion spring 94 acts upon the members 92 above their pivot points to swing their upper ends outward. The action of the spring is controlled through adjustable stop screws 95 in the ends of the lower arms of the L-shaped members 92 which

engage a vertically movable actuator 96 which in turn is secured upon the end of a vertical rod 97. The rod passes freely through an aperture in the base member 64 and an aligned aperture in the crosshead 81. The lower end of the rod 97 has secured thereto a bifurcated head 98 having a roll 99 pivoted therein which engages the periphery of a cam 100 secured upon the shaft 67. The cam 100 is designed to actuate the members 92 in the proper timed relation to the other elements of the mechanism. In Figs. 2 and 12 the hammer members 92 are shown in operative position to engage and flatten the wires while they are held in spaced position, the roll 99 being at this time on the high point of the cam 100.

Next in line to the first portion of the mechanism of station C above described is a lead wire manipulating device provided with a pair of operating arms 101 pivoted upon the parallel shafts 93. These arms are swung into and out of operating position by means of the actuator 96 which is made sufficiently wide to engage adjusting screws 102 secured in the lateral projections of the arms 101. The screws 102 are maintained in contact with the actuator 96 by a spring 103 urging the arms outward.

The arms 101 are swung outward and inward at the same time as the arms 92 because they are both actuated by member 96.

The arms 101 are provided with apertures 104 within which are received vertically movable fingers 105 which are held in their upper positions by springs 106 abutted against the lower ends of the fingers 105. The fingers are provided with lateral projections 107 in the form of screws threaded into the fingers 105. The projections extend through slots 108 in the inner walls of the arms. As shown in Fig. 13 the members 107 are positioned in the upper ends of the slots 108 which determines their upper position.

The upper ends of the fingers are provided with heads 109 having secured thereto relatively thin wire positioning blades 110. These blades have angularly disposed edges 111 and horizontal edges 112 at the upper end of the angular edges.

The fingers 105 are actuated by a rod 113 which is vertically movable within the post 78 and the rod 79 and extends beyond the lower end of the rod 79. 113 has a bifurcated head therefor containing a roll 114 which engages a cam 115 secured upon the shaft 57. The upper end of the rod 113 is bent inward at right angles and extended into the plane of the arms 101.

The horizontal portion of the rod 113 overlies the projections 107 and has a head 116 mounted thereon which overlies and engages the projections 107 thereto. Desirably the head 116 is loosely mounted on the rod 113 to insure equalized pressure of the dies 110 upon the wires 2. The roll 114 is held upon the cam 115 by a spring 117 upon the rod 113. The cam 115 acts to move the positioning blades 110 downward immediately after the arms 101 have been moved into their vertical position. Directly below the blades 110 is secured a co-operating die member 118 secured to an extension 119 of the member 90. The member 118 has its end portions shaped complementary to the blades 110 and functions to engage and position the wires upon their predetermined working axis at a position closer to the ends thereof. The blades 110 when lowered act to reposition the wires laterally if they should be out of position and also act to move the wires into the correct horizontal plane as determined by the horizontal edges 112 which force the wires down upon the top surface of the extension 119.

The outer ends of the lead wires 2 are given their final accurate position by the action of positioning arms 120. These arms are pivoted upon the common pivot shafts 93 and are swung outward and inward in a manner similar to the arms 92 and 101. These arms are moved outward by the spring 121 and are controlled in their movement by the actuator 122. The member 122 is secured upon the end of a vertical rod 123 which is mov-

ably guided through the members 77, 64 and 81 and has secured upon its bottom end a roll carrying head 124 having a roll 125 pivoted therein. The spring 121 acts to hold the roll 125 upon a cam 127 secured upon the shaft 67.

The actuator 122 engages contacting screws 128 in the horizontal portions of the arms 120. The cam 127 is timed to swing the arms outward while the member 76 is moved up into and withdrawn from its working position and inward while they are in working position. The arms 120 are provided with vertical apertures 129 therein within which are movably received the rods 130 upon the upper ends of which are secured coaxing wire positioning members 131 having V-shaped notches 132 therein. As shown in Fig. 14 the members 131 are in their inactive position. In their active position they are moved together into overlapping relation with the apexes of the slots 132 positioned to embrace and hold the wires exactly in their correct position for threading the base pins thereon. To accomplish this end the rods 130 are provided with projections 133 and 134 which extend through slots in the arms 120. The rod 130 bearing the projection 134 is urged upward by a spring 135 in the bottom of the aperture 129 while the rod 130 is urged downward by the spring 136. The spring 136 surrounds the reduced bottom end of the rod and seats at its upper end upon a shoulder formed by counterboring the aperture 129. The bottom end of the spring bears against a washer 137 secured to the rod. Thus the spring under compression urges the rod downward.

To operate the members 131 a special cam type lever 138 is provided. This lever is mounted upon an operating shaft 139 rotatably mounted in the right hand upright 78 of the member 76. The lever 138 has oppositely projecting arms one of which overlies the projection 134 of the rod 130 while its other arm extends below the extension 133 of the other rod 130. When the shaft 139 is rotated clockwise as viewed in Fig. 15 the members 131 function to position the ends of the lead wires to be received in the hollow pins of the lamp base. To operate the shaft it is provided at its outer end with a lever 140 which is connected to a link 141 which in turn connects to a second lever 142 which is pivoted at substantially its midpoint upon the upright 78.

The lever 142 is actuated by connection at its inner end to a vertically movable rod 143 the upper end of which is bent to present a horizontal portion which extends into a slot in the end of the lever 142. The rod 143 extends downward through the guide rod 79 and has secured to its bottom end a roll holder having a roll 144 rotatably mounted therein. A spring 145 surrounds the rod and acts to hold the roll 144 against a cam 146 mounted on the shaft 67. The cam is properly designed to actuate the members 131 through the actuation of the lever 138 which engages the extensions upon the rods 130 thus lowering the right hand rod 130 and raising the other rod until the wires are clamped between the apexes of the notches 132 in the members 131 at which time the ends of the wires are exactly positioned in alignment with the pins in the lamp base. The cam 146 then acts to move the rod 143 down which permits the springs 135 and 136 to move the members 131 apart. The wire ends are now accurately positioned in line with the lamp pins. The horizontal end of the rod 143 moves in a slot 147 in the member 78. At this time also the cam 127 acts to swing the arms 120 outward.

A lamp base 74 has placed in its holder 73 upon the end of the shaft 68 with the pins thereof extending into the slots 148 in the holder. The cam 70 now acts to move the base inward until the lead wires enter the apertures in the pins at which time it dwells for a brief period while the unit 76 and all the elements thereof are moved down by the action of their respective cams. The base is then moved in until it seals against the lamp with the lead

wires projecting slightly from the ends of the pins as shown in Fig. 1.

The wires are subsequently cut off and soldered to the pins. Desirably the base contains the desired amount of cement to insure its permanent adherence to the lamp.

Fig. 6-A illustrates a modified construction of the anvil 60. The modified anvil 149 functions generally in the same manner of the anvil 60 but is provided with yielding side plates 150 and 151. The plates are supported by a pair of pins 152 desirably but not necessarily arranged as shown wherein they are loosely received in apertures 153 in the anvil. One end of each pin is secured rigidly in one of the plates for example the plate 150 as by riveting while their other ends are loosely received in apertures in the plate 151.

The pins 152 are provided with heads to maintain their connection with the plate 151. The plates are held in spaced relationship slightly greater than the width of the anvil by a pair of springs 154 passing through apertures in the anvil and butting against the inside faces of the plates 150 and 151. In operation when the rolls 55 move inward they engage the wires 2 which in turn engage the plates 150 and 151 which are yieldingly held by the springs 154. In the event that the wires should vary in size or that there should be a variation in pressure of the rolls upon the wires due to unsymmetrical mechanical conditions the pressure is automatically equalized by the spring pressed and floating plates 150 and 151.

What we claim is:

1. Apparatus for orienting the lead-wires of an electrical device and positioning a base on the electrical device with the lead-wires extending through apertures therefor in the base, said apparatus comprising: a conveyor for carrying the electrical device to a plurality of work stations; means, located at one of said stations, for positioning the lead-wires of the electrical device in a common plane; means, located at a second station, for positioning the lead-wires of the electrical device parallel to and spaced a predetermined distance from one another; a base-supporting means located at a third station; means, located at said third mentioned station, for gripping the lead-wires at a plurality of points along their longitudinal axes, to hold them fixed with respect to one another; means for effecting relative movement between the electrical device and a base held by said base-supporting means to thread the lead-wires through the apertures in the base and position the base on the end of the electrical device; and means for moving said wire-gripping means at said third-mentioned station into and out of engagement with the lead-wires, said wire-gripping means moving into gripping engagement with the lead-wires immediately before they are threaded into the apertures in the base, and said wire-gripping means moving out of gripping engagement with the lead-wires immediately after they have been threaded into the apertures in the base to thereby permit further threading and positioning of the base on the end of the electrical device.

2. Apparatus for orienting the lead-wires of an electrical device and threading them into apertures in a base for the electrical device, said apparatus comprising: a conveyor for carrying the electrical device to a plurality of work stations; means located at one of said stations for effecting a preliminary orientation of the lead-wires; means located at a second station for effecting a further orientation of the lead-wires; a base-supporting means located at a third station; means located at said third-mentioned station for gripping the lead-wires at a plurality of points along their longitudinal axes to hold them fixed with respect to one another; and means for effecting relative movement between the electrical device and a base held by said base-supporting means, while the lead-wires are so gripped, to thread the lead-wires into the apertures in the base.

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