

June 1, 1954

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2,680,236

CRIMPED CONTACT PIN ASSEMBLY

Filed Aug. 22, 1950

2 Sheets-Sheet 1

Fig. 1.

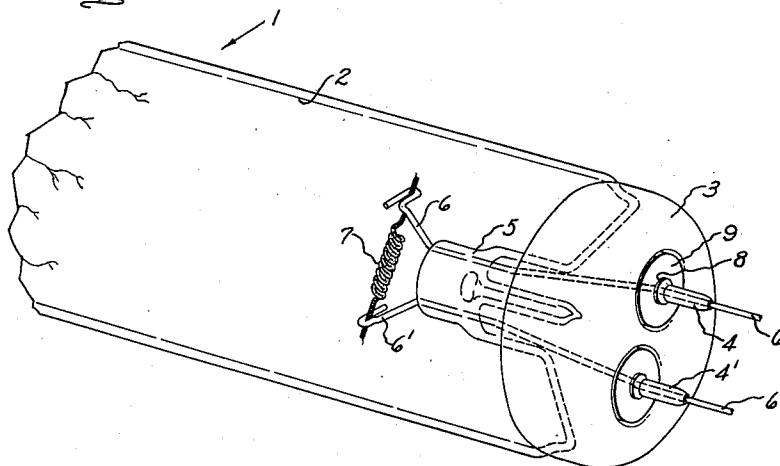
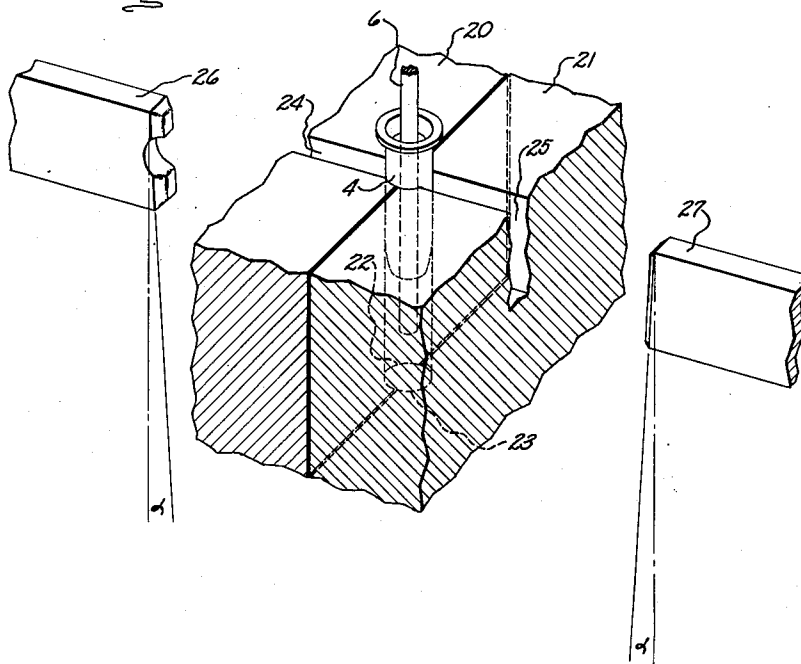


Fig. 6.



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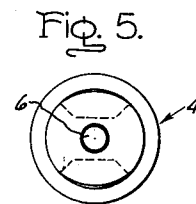
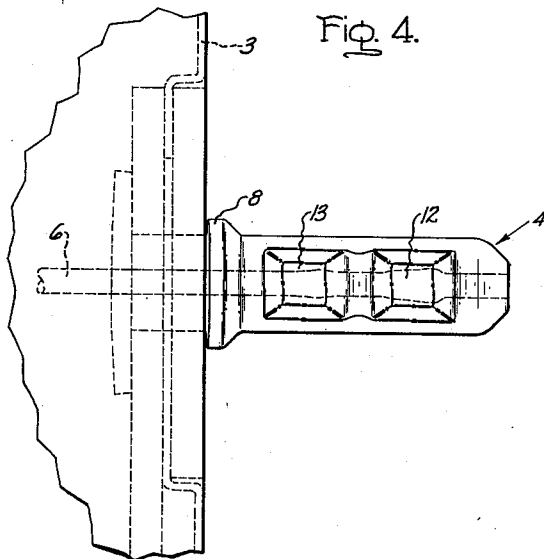
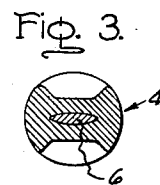
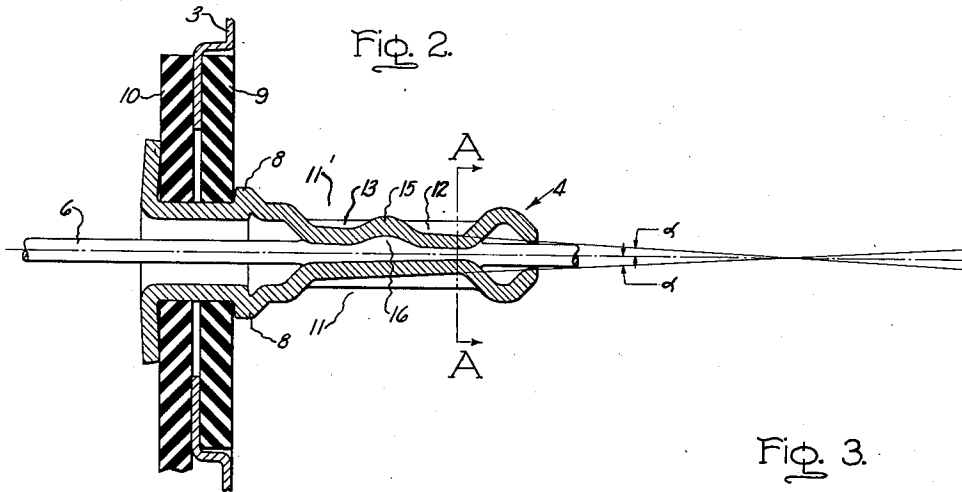
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CRIMPED CONTACT PIN ASSEMBLY

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Application August 22, 1950, Serial No. 180,818

9 Claims. (Cl. 339-145)

1

This invention relates generally to outside terminal connectors for electric discharge devices such as fluorescent lamps and vacuum tubes, and more particularly to a solderless contact pin assembly wherein a tubular pin is crimped over a lead-in wire threaded therethrough.

In the manufacture of fluorescent lamps, the commercial practice up to the present time has been to utilize hollow tubular brass contact pins in the bases and to provide a solder connection to the lead-in wires. Manual labor is employed for performing the soldering operation. Although soldered contact pins are quite satisfactory, they are relatively expensive due to the amount of labor involved; and they have necessitated the use of a relatively expensive material, namely brass, for the pin material. Thus, it has not proven feasible to utilize aluminum contact pins because of the difficulty of soldering the lead wires to that metal.

The principal object of the invention is to provide a new and improved solderless contact pin assembly which is particularly adapted to manufacture by automatic machines.

Another object of the invention is to provide an improved contact pin to lead wire assembly which permits the use of pins made of a less expensive metal which could not readily be soldered or brazed.

Another object of the invention is to provide an improved contact pin to lead wire crimped assembly which has low contact resistance, high immunity to shock and vibration, and wherein the mechanical strength of the contact pins is not diminished as a result of the crimping operation.

Yet another object of the invention is to provide a crimped contact pin to lead wire assembly for an electrical discharge device in which, during the crimping operation, the lead wires are stretched in the direction of the seals in the envelope of the lamp or device, from which the wires emerge. Stretching of the lead wires in this manner obviates any tendency towards breakage of the seals as a result of the crimping operation.

In accordance with the invention, the base and contact pin assembly for a discharge device comprises a tubular contact pin rigidly mounted on a support base affixed to the lamp with the lead wire threaded through the pin from its inner end, adjacent the lamp and seal, to its outer end where it is cut off. The pin is crimped by means of corresponding longitudinal indentations on opposite sides, and the indentations are inclined away from the longitudinal axis of the pins in the direction of the inner end. In other words, the crimping indentations on opposite sides of the pin are deeper at the end of the pin removed from the lamp than they are at the end adjacent the lamp. This causes a stretching or flow of the wire from the outer end towards the inner

2

end, that is, in the direction of the seal, so that any tendency towards breakage of either the seal or the wire is obviated. In the preferred embodiment of my invention, one of the indentations has a break near its middle, so that, in fact, one long indentation appears on one side of the pin and two shorter indentations on the other side with a nonindented portion in between. This construction causes a differential flow of the lead wire metal during the crimping which results in the formation of a pocket in the pin and the compression of the lead wire metal into a lump at the center of this pocket. This construction prevents any longitudinal movement of the lead wire in the pin even though the pins should subsequently split open, as often occurs with the usual low cost pins formed from sheet metal and having a seam along one side.

For further objects and advantages and for a better understanding of the invention, attention is now directed to the following description and accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings, wherein like reference symbols refer to corresponding elements in the different figures:

Fig. 1 is a pictorial representation of one end of a fluorescent lamp of conventional design.

Fig. 2 is a side sectional view of a contact pin assembly illustrating a preferred embodiment of the invention.

Fig. 3 is a transverse sectional view in the plane AA of the contact pin assembly of Fig. 2.

Figs. 4 and 5 are plan and end views, respectively, showing the external appearance of a finished contact pin assembly, as in Fig. 2.

Fig. 6 is a simplified pictorial representation of a mechanism comprising confining compression dies and indenting punches for making a contact pin and lead wire assembly in accordance with my invention.

Referring to Fig. 1, there is shown an end of a commercial fluorescent lamp 1 of conventional design comprising a glass envelope 2 having its extremity slightly reduced in diameter for the securing thereto of a cup-shaped base 3 to which the contact pins 4 and 4' are anchored. The envelope 2 has a re-entrant portion which is flattened at its inner end into a press 5 through which pass the filament mounting and lead-in wires 6 and 6'. A filament 7, which may be the usual coiled tungsten wire coated with activated electron-emitting material, is mounted transversely across the inner ends of the mounting wires 6, 6' within the envelope 2.

The end cap or base 3 is usually formed of thin sheet metal such as brass or aluminum. Accordingly, it is necessary to provide some means for insulating the contact pins from the base. As may be seen in Fig. 2, the pin is provided with an outer annular flange or shoulder

3

8 and is mounted in an oversize hole in an inwardly countersunk portion of the base 3, which portion forms a circular depression for locating an outer insulating washer 9. A similar insulating washer 10 is located on the inner side of the base 3 and facing the outer washer 9. The inner end or extremity of the pin is rolled over or overturned by a staking operation so as to firmly anchor the pin and the insulating washers together. The lead wire 6 is threaded through the bore of the tubular pin 4 in order to permit external connections to the filament 7. As may be seen in the drawing, the lead-in wire has a diameter considerably less than the bore of the pin and fits quite loosely within it.

It has formerly been the practice in the electric lamp industry to solder the pin 4 and lead wire 6 together in order to provide a firm low resistance contact. The soldering operation unavoidably necessitated that the pin be composed of a material which is readily tinned or wetted by commercial low melting point soldering compositions. Accordingly, the pins were usually of brass and the lead wires of a copper alloy. These requirements are avoided by my invention and the pins may accordingly be made of metals not readily soldered, for instance aluminum.

Numerous attempts have been made, previous to the present invention, to crimp the pins and lead wires together and avoid the soldering operation. In order to understand why these crimping attempts have generally proven commercially unsatisfactory, it might be mentioned that there are rather stringent requirements imposed upon the assembly. Firstly, the mechanical strength of the pins must not be unduly impaired because the lamps are normally held in the lamp holders or sockets solely by the pins. Secondly, breakage of the lead wires or of the seals must be kept within reasonably low limits. In the manufacturing operation of threading the lead wire through the pin, the operator is required to take up any looseness in the lead wire so as to obviate any possibility of contact between each wire in the pair at each end of the lamp. As a result, the operator generally gives a sharp tug to the lead wire, thereby pulling it up tautly and leaving no slackness whatsoever in the lead wire between the inner end of the pin and the seal through the stem press. Thus, when the pin is crimped over the lead wire, it must not under any circumstances stretch the lead wire away from the seal because stretching in such a direction would almost unavoidably result in breakage of the seal or of the wire.

Another requirement which must be met is that the lead wire must be firmly anchored within the pin and not be allowed to slide longitudinally within the pin. The pins are thin-walled and it might also be mentioned that they are usually made of sheet metal and have a seam along one side so that quite often the seam splits open; and unless some positive means of locking the wire within the pin is provided, a loose contact will result.

In accordance with the invention, a crimped contact pin and lead wire assembly has been made which has been found completely satisfactory and ideally suited for machine manufacture. The pin is crimped on opposite sides with longitudinal wedge-shaped indentations which taper away from the axis of the pin in a direction towards the lamp or inner end of the pin. In other words, the indentations are deeper at the outer end of the pin than at the inner. Thus, referring to

4

Fig. 2, the lower indentation 11 is seen to slope away from the axis of the pin at an angle α . For the usual pin assembly utilized with commercial fluorescent lamps, wherein the pins project approximately $\frac{1}{4}$ inch from the base and have a diameter of approximately $\frac{3}{8}$ inch, the angle of slope of the indentation, as denoted by α , may be approximately 6° . The angle made by the intersection of the planes through the bottoms of the indentations on both sides of the pin would then be approximately 12° .

It will be observed that the upper indentation shown in Fig. 2 is different from the lower indentation and has, in fact, a boss or ridge at its center. This represents a preferred form of my invention; however, it is not strictly necessary and very good results may be obtained with indentations similar to the lower indentation 11 on both sides of the pin. As a result of the slope in the indentation, the lead wire 6 is squeezed initially at a point at the right-hand end of the indentation and is thereafter progressively squeezed towards the left-hand end. This results in a flow of the lead wire metal towards the left or, in other words, towards the lamp and the seal in the stem press. Accordingly, the wire is stretched so as to lengthen it and increase the slack between the stem seal and the pin. In an actual construction utilizing standard fluorescent lamp pins, the stretch in the wire, with a 6° taper in both indentations as shown in Fig. 2, was approximately .015 inch. This is adequate to prevent breakage of the seal during the crimping operation, and also to prevent subsequent breakage due to expansion of the base during operation of the lamp.

During the operation of the lamp, the ends of the envelope and the bases heat up by reason of the proximity of the discharge and of the hot electrode. However, the contact pins and the lead wires do not heat up to the same extent because they dissipate heat through conduction to the metallic parts of the lampholders. Accordingly, the bases expand laterally, that is, in a direction forcing the contact pins away from the end of the lamp, whereas the lead wires do not expand to the same extent. The result is that, unless corrective measures are taken, the lead wires may break or the glass seals may be fractured. With the crimped pin construction of the invention, on the other hand, the slackness provided in the lead wires as a result of the stretch produced by the crimping operation prevents any breakage or fracture.

In accordance with the preferred form of my invention, the upper indentation 11' is formed as a pair of smaller indentations 12, 13 with a break or raised portion in between. It will readily be seen that it is possible to form such an indentation by means of a split punch or by means of a punch having a face similar to that for making the depression 11 but with a cutaway portion in the center of the face. The result of making a break in the upper indentation is to cause a differential flow of metal under the upper indentations 12 and 13 which produces a pocket in the pin metal and a gathering of the wire metal into a lump under the pocket. Thus, the pin material is pocketed at 15 and the lead wire material or metal is lumped at 16. This feature provides for positively locking the lead wire within the pin and prevents any possibility of the lead wire sliding longitudinally within the pin and, moreover, assures positive contact.

It is very important that the lead wire be

5

firmly united to the pin in order that good electrical contact be maintained under all conditions. It has been found that poor or high resistance connections between the lead wires and the pins in fluorescent lamps are one of the most fruitful causes of radio interference. The interference appears to result from the occurrence of tiny arcs at the loose connections, and the effect is aggravated when the lamps are subject to vibration. With soldered connections, the high resistance contacts may be caused by the wire breaking away from the solder under thermal stresses.

With the double indentation crimp in accordance with the invention, a good contact between the lead wire and the pin is assured at all times, no matter what stresses or vibrations are applied to the lead wire. This may be understood in the following fashion. Assuming that tension is applied to the lead wire in a direction to pull it back towards the seal, the wire may possibly move under the inner indentation 13. This could lead to a high resistance contact at that point. However, the movement of the wire cannot extend past the break point in the upper indentation because the wire is anchored there through the lumping of the wire material at 16 under the pocket in the pin material at 15. Thus, no stress can be transmitted to the wire under the outer indentation 12 which thereby assures at all times a good low resistance contact.

Referring to Fig. 3, wherein there is shown a cross section along the line AA of the pin and lead wire under the indentation 13, it will be seen that the pin is deformed from its tubular shape into an approximate I-beam cross section. The rigidity of an I-beam cross section is almost equal to that of a tubular cross section containing the same amount of material. Accordingly, the rigidity of the pin is hardly affected by the crimping operation. It has been found in actual practice that the lead wire and pin material are sweated together by the pressure of the crimping operation, and a very low contact resistance is achieved. Moreover, the union is so close that air cannot enter between the surfaces; and, accordingly, oxidation and resulting high contact resistances cannot occur.

Figs. 4 and 5 are plan and end views, respectively, of the pin and show its appearance after crimping. The general cylindrical shape and overall external dimensions are substantially unchanged, and the crimping merely causes depressions without deforming other portions of the pin. It will be understood that in actual practice the lead wire 6 is cut off flush with the outer end of the pin so as not to leave any sharp projections.

Referring to Fig. 6, there is shown a cutaway portion of a mechanical assembly for indenting a pin and lead wire assembly to achieve the result depicted in Figs. 2 to 5. The assembly comprises a pair of confining compression dies 20 and 21, each of which has a semicylindrical groove 22 and 23 in corresponding locations on their contacting faces. When the compression dies are brought together, these grooves together form a cylindrical recess or cavity in which the pin is held and serve to retain the shape of the pin and prevent any distortion thereof during the process of indenting or crimping it. Slots 24 and 25 are cut into the compression dies and abut inwardly against the semicircular grooves 22 and 23. These slots form channels through the compression dies for allowing the inward

6

movement of a pair of punches 26 and 27 against the pin, thereby to crimp it and achieve the indentations shown in Fig. 2. The punches have wedge-shaped fronts, of which the forward faces are inclined at an angle α to the vertical, and punch 26 is also split near its center. The dies and associated equipment are fully described in copending application No. 180,819 of John W. Fulton jointly with myself, filed August 22, 1950, entitled Contact Pin Crimping Machine, and assigned to the same assignee as the present invention. Reference may be had to that application for a complete description of an automatic machine for making the contact pin assembly described in the present application.

While a certain specific embodiment has been shown and described, it will of course be understood that various modifications may be made without departing from the invention. Thus, the actual contour of the pins and of the indentations may be changed to suit, provided always the essential features of the assembly in accordance with the invention are maintained. These consist generally in sloping the indentations away from the axis of the pin in the direction wherein stretch is required and, preferably, splitting the indentation on one side to cause a pocketing of the pin and a cooperating lumping of the wire material. Moreover, whereas the invention has been described with reference to a contact pin base assembly for a fluorescent lamp, it is not restricted thereto and is equally applicable to assemblies used with other discharge devices, lamps, and radio tubes wherein the same general problems are encountered. The appended claims are, therefore, intended to cover any such modifications coming within the true spirit and scope of the invention.

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

1. A contact pin assembly for an electrical device, comprising a tubular contact pin having inner and outer ends, a lead wire threaded longitudinally through said pin from its inner to its outer end, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said inner end and said wire being locally deformed in cross section and stretched from said outer towards said inner end as a result of the inclination in said indentations.

2. A contact pin assembly for providing a terminal connector for a lead wire of an electrical device, comprising a tubular contact pin having a longitudinal bore extending between inner and outer ends, a lead wire threaded through and of smaller diameter than said bore, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said inner end and said wire being locally deformed in cross section and stretched from said outer towards said inner end as a result of the inclination of said indentations.

3. A contact pin assembly for an electrical device of the type wherein a lead wire emerges from an envelope through a seal, comprising a thin-walled hollow contact pin having its inner end located near said seal, a lead wire threaded through said pin from its inner end to its outer end and having a diameter less than the bore

of said pin, and corresponding longitudinal indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said inner end and said wire being locally deformed in cross section and stretched from said outer towards said inner end as a result of the inclination of said indentations, thereby to provide slackness in said wire between said inner end of the pin and said seal.

4. A contact pin assembly for an electrical device, comprising a tubular contact pin having inner and outer ends, a lead wire threaded longitudinally through said pin from its inner to its outer end, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said inner end and said wire being locally deformed in cross section and stretched from said outer towards said inner end as a result of the inclination of said indentations, and a break in one of said indentations forming a pocket in the material of said pin and a lumping thereunder of the material of said wire, in order to anchor said lead wire firmly and prevent any longitudinal movement thereof within said pin.

5. A contact pin assembly for an electrical device of the type wherein a lead wire emerges from an envelope through a seal, comprising a thin-walled hollow contact pin having its inner end located near said seal, a lead wire threaded longitudinally through said pin from its inner to its outer end and having a diameter less than the bore of said pin, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said inner end and said wire being locally deformed in cross section and stretched from said outer towards said inner end as a result of the inclination of said indentations, and a break in one of said indentations forming a pocket in the material of said pin and a lumping thereunder of the material of said wire, in order to anchor said lead wire firmly and prevent any longitudinal movement thereof within said pin.

6. A contact pin assembly for an electrical device comprising an envelope having a lead wire emerging from a seal, a base secured near said seal, a tubular contact pin anchored to said base at its inner end and having said lead wire threaded longitudinally therethrough to its outer end, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having longitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said base and said wire being locally deformed in cross section and stretched from said outer towards said inner end and said seal as a result of the inclination of said indentations.

7. A contact pin assembly for an electric discharge device comprising an envelope having a lead wire emerging from a seal, a base secured near said seal, a tubular contact pin anchored to said base at its inner end and having said lead wire threaded longitudinally therethrough to its outer end, and corresponding elongated indentations on opposite sides of said pin crimping it to said wire, said indentations having lon-

gitudinally elongated inner faces inclined away from the longitudinal axis of said pin in the direction of said base and said wire being locally deformed in cross section and stretched from said outer end toward said inner end and said seal as a result of the inclination of said indentations, and a break in the middle of one of said indentations forming a pocket in the material of said pin in order to anchor said lead wire firmly as a result of the lumping of the lead wire under said pocket.

8. A contact pin assembly for an electrical device comprising an envelope having a lead wire emerging therefrom through a seal, a base secured to said envelope near said seal, a thin-walled hollow contact pin anchored to said base at its inner end and having said lead wire threaded longitudinally through its bore from its inner to its outer end, and corresponding elongated indentations on opposite sides of said pin crimping said pin to said lead wire, said indentations being substantially parallel to the longitudinal axis of said pin and having sloping faces inclined away from said axis at a shallow angle in the direction of said base, said lead wire being locally deformed in cross section and stretched through the bore of the pin from said outer end towards said inner end and said seal as a result of the inclination of said indentations, and one of said indentations having a break constituting a nonindented portion in the center thereof forming a pocket in the material of said pin and a lumping thereunder of the material of said wire, the lumping of the lead wire material in said pocket resulting in the firm anchoring of said lead wire to said pin.

9. A contact pin assembly for an elongated electric discharge lamp, comprising an envelope having a lead wire emerging therefrom through a seal at one end, a base secured to said end of the envelope, a hollow tubular contact pin anchored to said base at its inner end and having said lead wire threaded through its bore to its outer end, and corresponding elongated wedge-shaped indentations on opposite sides of said pin crimping said pin to said lead wire, said indentations being generally parallel to the longitudinal axis of said pin and having sloping bottom faces inclined away from said axis at a shallow angle in the direction of said base, said lead wire being locally deformed in cross section and stretched from said outer end towards said inner end as a result of the inclination of said faces, thereby obviating possible breakage of said seal, and one of said indentations having a break in the center thereof constituting a nonindented portion forming a pocket in the material of said pin, and a differential stretch in said lead wire caused by said break and resulting in the lumping of the material of said lead wire thereunder, the lumping of the lead wire material under said pocket resulting in the firm anchoring of said lead wire to said pin.

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