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 [21] Appl. No. **846,766**
 [22] Filed **Aug. 1, 1969**
 [45] Patented **July 27, 1971**
 [73] Assignee **General Electric Company**

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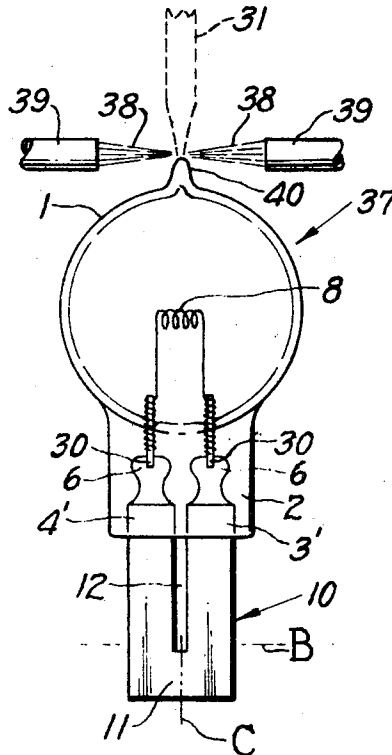
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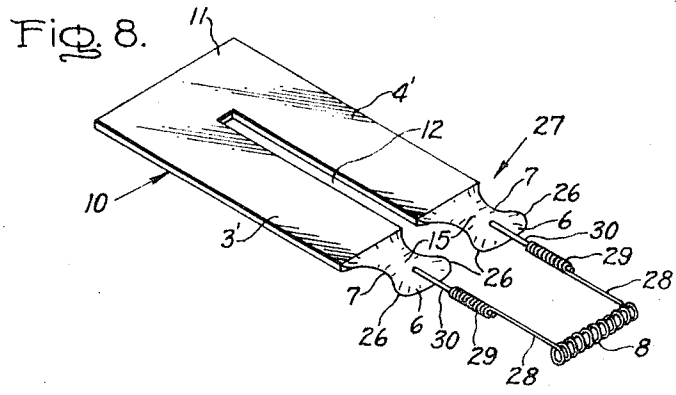
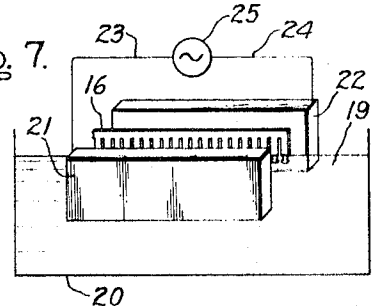
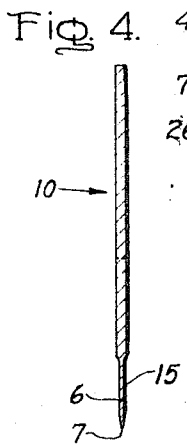
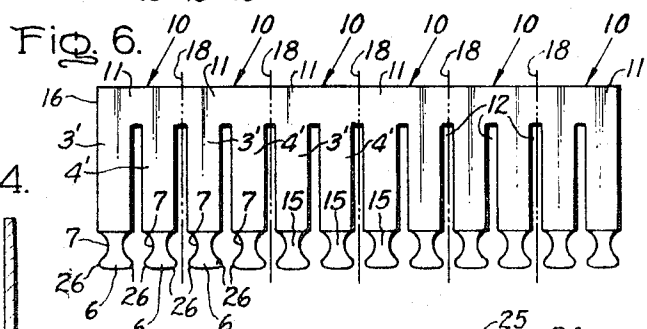
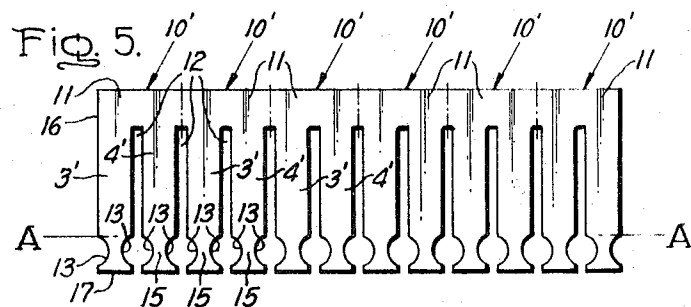
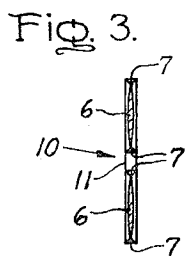
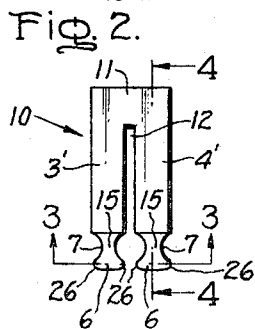
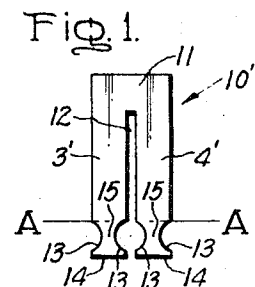
[54] **METHOD OF MANUFACTURING AN ELECTRICAL DEVICE**
 7 Claims, 14 Drawing Figs.

[52] U.S. Cl..... 29/25.15,
 29/25.13
 [51] Int. Cl..... H01j 9/18,
 H01j 9/36
 [50] Field of Search..... 29/25.1,
 25.11, 25.13, 25.15

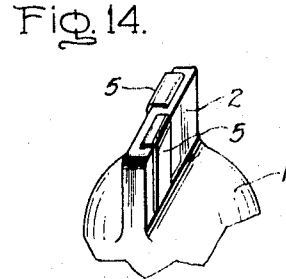
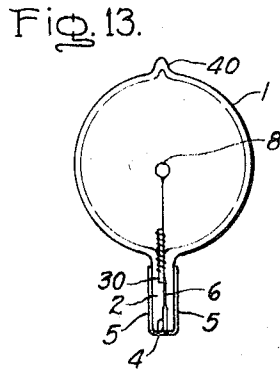
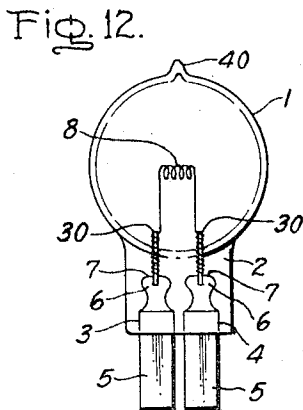
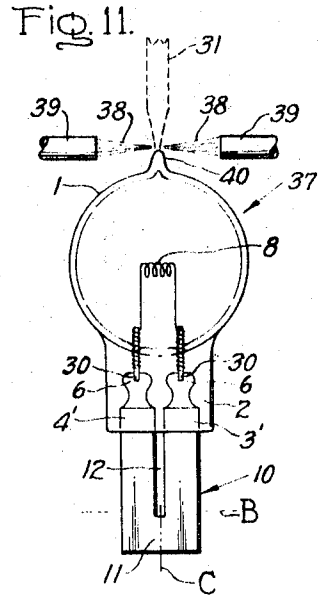
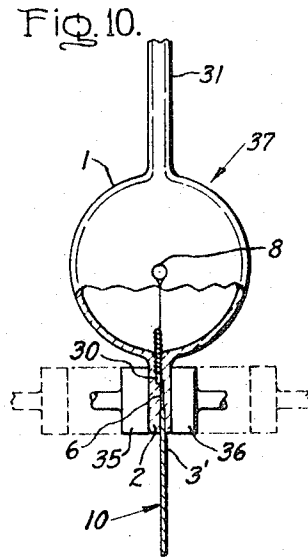
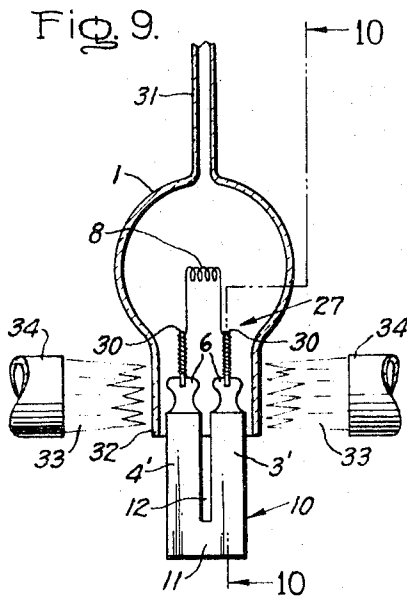
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ABSTRACT: A method of making an electric lamp comprises the steps of forming a metal foil lead-in conductor blank of U-shaped configuration having the free ends only of its two leg portions etched to feather the edges thereof completely therearound, connecting a filament to the tip ends of the etched leg end portions of the blank, sealing the neck end of a vitreous envelope around the etched leg end portions of the foil blank while leaving the other or bight end thereof projecting outwardly of the envelope from the pinch seal, and then severing the foil blank at its bight end into two separate foil lead-in conductors spaced apart from one another. An electric lamp made by this method may have the projecting outer end portions of the two foil lead-in conductors folded back around the same one or around opposite ones of the flat sides of the pinch seal.





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METHOD OF MANUFACTURING AN ELECTRICAL DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates, in general, to electrical devices such as electric incandescent and discharge lamps of the type employing metal foil seals, and to a method of making such devices.

The manufacture of halogen regenerative cycle incandescent lamps of the single-ended type, wherein the lamp contact terminals extend from one end of a lamp envelope of essentially fused silica such as quartz, or a material commonly known as 96 percent silica glass or Vycor, heretofore has entailed the fabrication of a lamp mount by an involved manufacturing procedure requiring a considerable number of component parts and separate manufacturing operations all of which add materially to the cost of the finished lamp. For example, the lead-in conductors of such lamps generally have each comprised a three-part assembly consisting of inner and outer wire leads which are individually welded to opposite ends of a specially prepared metal foil seal lead section. Because of the rather flimsy character of these thin metal foil seal lead sections of these composite lead-in conductors, they must be handled with extreme care at all times, i.e., not only during the fabrication of the lead-in conductors themselves but also during the fabrication thereof into the lamp mounts and the sealing of the lamp mounts into the lamp envelopes.

Besides their high manufacturing cost due to the above-mentioned considerations, such prior type single-ended halogen regenerative cycle incandescent lamps also are characterized by occasional misaligned filaments as well as occasional premature lamp failure due to corrosion of the outer leads and outer welds of the lamp mount which causes the eventual failure of the hermetic seal of one or both of the lead-in conductor assemblies into the quartz envelope of the lamp. This susceptibility of such prior-type halogen cycle incandescent lamps to seal failure has accordingly imposed a limitation on the temperature, and therefore on the attainable light output, at which the lamps can be safely operated without likelihood of the lead-in conductor seals failing prematurely.

SUMMARY OF THE INVENTION

It is an object of the invention, therefore, to provide a novel method of making single-ended electric lamps or similar devices having metal foil type lead-in conductor seals.

A further object of the invention is to provide an improved method of making single-ended electric lamps or similar devices having metal foil-type lead-in conductor seals whereby accurate prealignment of the lamp filament with the lamp base can be achieved with comparative ease.

A still further object of the invention is to provide a single-ended electric lamp or similar device having an improved and simplified metal foil-type lead-in conductor seal and end contact terminal arrangement.

Briefly stated, in accordance with one aspect of the invention, electric lamps or similar devices of the single-ended-type employing metal foil lead-in conductor seals are made by forming a metal foil lead-in conductor blank of U-shaped configuration with the free end portions only of its two legs etched to feather the edges thereof completely therearound, electrically connecting a filament or other electric energy translation element to the tip ends of the etched leg end portions of the foil lead-in blank, fusing and pinch-sealing the neck end of a vitreous envelope around the etched leg end portions of the foil lead-in blank while leaving the bight end portion thereof projecting outwardly of the envelope from the pinch seal, and then severing the foil lead-in blank at its bight end into two separate foil lead-in conductors spaced apart from one another. In accordance with a further aspect of the invention, the projecting outer end portions of the two separated foil

lead-in conductors may be folded back around flat sides of the pinch seal to serve as the terminal contacts of the device.

Further objects and advantages of the invention will appear from the following detailed description of species thereof and from the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a plan view of the metal foil lead-in conductor blank which is employed in the manufacture of an electric lamp in accordance with the invention;

FIG. 2 is a plan view of the metal foil lead-in conductor blank of FIG. 1 after the electrolytic etching of the free end portions of the two legs thereof;

FIGS. 3 and 4 are sectional views, on an enlarged scale, on the lines 3-3 and 4-4, respectively, of FIG. 2;

FIGS. 5 and 6 are views illustrating the successive steps in manufacturing the lead-in conductor blank of FIG. 2 according to a modified procedure;

FIG. 7 is a diagrammatic view illustrating a method of electrolytically etching the metal foil lead-in conductor blank of FIG. 1 or the slotted metal foil ribbon of FIG. 5 in the manner according to the invention;

FIG. 8 is a perspective view, on an enlarged scale, of a completed lamp mount according to the invention ready for sealing into a vitreous lamp envelope;

FIGS. 9 to 11 are views showing the successive steps involved in sealing the lamp mount of FIG. 8 into a vitreous lamp envelope and tipping off the envelope to form a lamp according to the invention;

FIG. 12 is an elevation of a completed lamp comprising the invention;

FIG. 13 is an elevation of a modified form of lamp construction according to the invention; and

FIG. 14 is a fragmentary perspective view, on an enlarged scale, of the base end portion of the modified form of lamp construction shown in FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, the invention is there illustrated as embodied in and applied to the manufacture of electric incandescent lamps and similar devices of the single-ended type as shown in FIG. 12 and comprising a vitreous envelope 1 of essentially fused silica such as quartz or a material commonly known as 96 percent silica glass or Vycor and having a flattened pinch seal portion 2 at one end in which a pair of metal foil lead-in conductors 3 and 4 are embedded and hermetically sealed. The metal foil lead-in conductors 3, 4 are sealed into the pinch seal 2 in approximately parallel side-by-side relation, with their flat sides disposed flatwise in the flattened pinch seal, and they have outer contact end portions 5 which project outwardly from the pinch seal to serve as the terminal contacts for the lamp or other device. The metal foil lead-in conductors 3, 4 are formed with etched inner or tongue end portions 6, preferably of spade shape as shown, which terminate entirely within the pinch seal 2 and are etched so as to feather the edges thereof completely therearound to a sharp edge, as shown at 7. A tungsten filament 8 or other electric energy translation element is disposed within the interior space of the envelope 1 and is electrically connected at its opposite ends to the tip ends of the etched tongue end portions 6 of respective ones of the two lead-in conductors 3, 4.

In accordance with the invention, the manufacture of an electric incandescent lamp or similar device of the general type described above and shown in FIG. 12 is carried out by first fabricating a preformed metal foil lead-in conductor blank 10 (FIG. 2) of U-shaped configuration as shown in FIG. 2 and having a pair of leg portions 3', 4' conforming to the metal foil lead-in conductors 3, 4 of the finished lamp and extending in parallel relation from a bight portion 11, the free ends only of the two leg portions 3', 4' being etched to form tongue end portions 6, preferably of spade shape, feathered to

a sharp edge 7 completely therearound. The lead-in conductor blank 10 may be formed of thin metal foil such as, for example, molybdenum or tungsten foil having a thickness of, for instance, around 0.003 to 0.004 inch, and the two leg portions 3', 4' of the blank 10 correspond in length and width to that desired for the respective metal foil lead-in conductors 3', 4' of the finished lamp.

The metal foil lead-in conductor blank 10 may be formed by precutting or shearing an individual and as yet unetched U-shaped blank 10' (FIG. 1) from a ribbon of the metal foil and then subsequently electrolytically etching the free ends only of the leg portions 3', 4' of the precut blank 10' to form the feather-edged tongue end portions 6, 6 (FIG. 2) thereon. The two leg portions 3', 4' of the U-shaped metal foil blank 10' are formed by the center slot 12 therein, and they are spaced apart by the slot 12 a distance corresponding to that which they are to occupy in the finished pinch seal 2 (FIG. 12). The leg portions 3', 4' of the blank 10' are preferably formed with shallow U-shaped or approximately semicircular shaped notches 13 in their side edges, at regions located a short distance inwardly from their tip ends 14, so as to form necked down sections 15 of reduced width which, after the etching of the free ends of the leg portions 3', 4' up to and including their reduced width sections 15, as indicated by the etching limit line A-A (FIG. 1), results in the formation of tongue end portions 6, 6 of spade-shaped configuration on the legs 3', 4', as shown in FIG. 2. The spade-shaped configuration of the etched tongue end portions 6 thus affords a feathered sealing edge 7 of extended length on each tongue end portion 6 which acts to better assure a good hermetic seal of the metal foil legs 3', 4' into the quartz pinch seal 2 of the finished lamp.

As an alternative, the metal foil lead-in conductor blank 10 may be formed in the manner shown in FIGS. 5 and 6 by performing a ribbon 16 of the metal foil with a series of spaced slots 12 extending transversely inward from one side edge 17 of the ribbon, the slots 12 each being of the same shape as that of the corresponding slot 12 in the individual precut blank 10' of FIG. 1 and being spaced apart the required distance to subdivide the ribbon 16 into a series of alternate leg portions 3', 4' conforming to the legs 3', 4' of the individual precut blank 10' of FIG. 1 so as to, in effect, form the ribbon into an interconnected series of individual blanks 10' (FIG. 5) joined together at their bight ends 11. As in the case of the precut individual blanks 10' of FIG. 1, the legs 3', 4' of the preformed ribbon 16 are preferably formed with notches 13 in their side edges so as to form reduced width sections 15 therein similar to those in the blank 10' of FIG. 1. The slotted edge portion of the preformed ribbon 16 is then electrolytically etched, throughout only that extent of its width extending from the edge 17 thereof inwardly to the innermost end of the notches 13 therein, as indicated by the line A-A in FIG. 5, to form the leg portions 3', 4' with etched tongue end portions 6, 6 of spade-shaped configuration and feathered to a sharp edge 7 completely therearound, as shown in FIG. 6. The etched ribbon 16 is then transversely severed at alternate ones of the slots 12 therein, along the cutting lines 18 as shown in FIG. 6, to thereby separate the ribbon 16 into individual foil lead-in conductor blanks 10 of the form shown in FIG. 2.

The electrolytic etching of the metal foil blank 10' of FIG. 1, or the ribbon 16 of FIG. 5, to form the feather-edged tongue end portions 6 thereon as shown in FIGS. 2 and 6, may be carried out in the manner shown in FIG. 7 and described in my copending application Ser. No. 828,863, filed May 29, 1969 and assigned to the same assignee as that of the present application, by immersing the slotted side of the blank 10' or ribbon 16 up to the etch line A-A (FIGS. 1 and 5) in a bath 19 of a suitable etching electrolyte such as, for instance, a 50 percent solution of sodium hydroxide in the case where the metal foil blank 10' or ribbon 16 is constituted of molybdenum, which electrolyte bath 19 is contained within an etching tank 20. The metal foil blank 10' or ribbon 16 is positioned in the electrolyte bath 19 between and in parallel relation to a pair of parallel-extending copper bar-type electrodes 21 and 22

which are likewise immersed in the electrolyte bath and which are respectively connected, as by electrical conductors 23 and 24, to the opposite sides of an AC power source 25. The etching of the metal foil blank 10' or ribbon 16 is continued until all the exposed edges of the tongue end portions 6 of the blank 10' or ribbon 16 are feathered to a sharp edge 7 and the corners of the tongue end portions 6 are rounded off, as shown at 26 in FIGS. 2 and 6. The length of time during which the metal foil blank 10' or ribbon 16 must be subjected to the electrolytic etching action in order to accomplish the above object will, of course, depend on various factors such as the amperage of the etching current applied to the electrodes 21, 22, the spacing of the metal foil blank 10' or ribbon 16 from the electrodes 21, 22, the composition and temperature of the electrolyte 19 employed, and the composition and thickness as well as the partial linear extent of the legs 3', 4' of the metal foil blank 10' or ribbon 16 to be etched. However, for a molybdenum metal foil blank 10' or ribbon 16 of approximately 0.003-inch thickness which is to be etched to a distance of around one-fourth to five-sixteenths inch from the tip ends 14 of the legs 3', 4', and which has its flat side surfaces spaced a distance of around one-half inch from the respective electrodes 21, 22, and with an electrolyte 19 at room temperature and composed of a 50 percent solution of sodium hydroxide, an etching time of approximately 1 to 2 minutes with an etching current of around 6 amperes applied to the electrodes 21, 22 ordinarily will suffice to accomplish the required degree of etching of the metal foil blank 10' or ribbon 16, as described above.

Etching is most rapid at the edges of the tongue end portions 6 of the foil blank 10' or ribbon 16 and is a maximum at the corners thereof. This causes the corners to become rounded as indicated at 26 in FIGS. 2 and 6, and the edges to become feathered to a sharp edge as illustrated at 7 in FIGS. 3 and 4. However, etching takes place all over the tongue end portions 6 of the metal foil blank 10' or ribbon 16 which are immersed in the electrolyte 19. Along the medial center line of the etched tongue end portions 6 of the metal foil blank 10' or ribbon 16, the thickness in the central region 15 thereof may be around half or less than half the original thickness of the metal foil prior to the etching thereof. Thus, where the original foil thickness was in the range of 0.003 to 0.004 inches, the thickness along the medial center line of each tongue end portion 6 at its central region 15 after etching may be around 0.001 inch. The thickness of the etched tongue end portions 6 of the blank 10 or ribbon 16 tapers transversely thereof to zero at the edges, as shown at 7 in FIG. 3.

Upon completion of the etching operation, the etched metal foil blank 10 or ribbon 16 is withdrawn from the electrolyte bath 19 and any remaining electrolyte on the blank 10 or ribbon 16 then removed therefrom in a suitable manner, as by washing it off either by directing a water spray against the opposite flat sides of the blank 10 or ribbon 16 or by immersing the metal foil blank 10 or ribbon 16 in a water rinse bath. Preferably, however, the remaining etching electrolyte on the metal foil blank 10 or ribbon 16 is removed therefrom by first immersing the blank or ribbon in a neutralizing acid bath to cause the remaining sodium hydroxide etchant, which is a base, to react with the acid to form a salt, and then washing off the resulting reaction product along with any acid or other foreign material remaining on the blank 10 or ribbon 16 in a suitable manner, preferably by directing a water spray against the opposite flat sides of the blank 10 or ribbon 16, followed by immersion thereof in an alcohol rinse bath, the alcohol absorbing any of the rinse water remaining on the blank 10 or ribbon 16 and being easier to dry off the blank or ribbon than the water alone.

After the formation of the metal foil lead-in conductor blank 10 (FIG. 2) as described above, the next step in the manufacture of an electric incandescent lamp according to the invention is the mounting of an electric energy translation element or filament 8 such as, for example, a coiled or coiled-coil wire of tungsten or other refractory metal, on the tip ends

of the etched tongue end portions 6 of the legs 3', 4' of the foil blank 10 to form a lamp mount 27 as shown in FIG. 8. The filament 8 may be mounted on the foil blank 10 either by welding or otherwise suitably fastening the opposite ends or end legs 28 of the tungsten wire filament 8 directly to the tip ends of respective ones of the etched tongue end portions 6 of the metal foil lead-in conductor blank 10, or by forming the end legs 28 with slipover coil portions 29 which are snugly fitted over straight wire spuds or inner leads 30 and the latter welded or otherwise suitably fastened to the tip ends of the tongue end portions 6 of the metal foil blank 10. As shown in FIG. 8, the inner wire leads or spuds 30 (or the wire end legs 28 of the filament 8 in the case where the wire leads 29 are omitted) preferably extend in parallel relation endwise from and centered relative to the tip ends of the etched tongue end portions 6 of the legs 3', 4' of the foil blank 10, thereby affording more or less symmetrical and uniform length feathered sealing edges 7 of metal foil around each of the welded joints of the inner wire leads or spuds 30 (or filament legs 28) to the tongue end portions 6 of the foil blank 10. Although the filament 8 is shown in the form of a linear coil, it may be of any other suitably shaped form.

The completed filament or lamp mount 17 is then enclosed within and sealed into an envelope 1 of fused silica such as quartz or a quartzlike glass such as that commercially known as 96 percent silica glass or Vycor, in the manner customary in the lampmaking art and shown in FIG. 9 for making pinch seals 2 of thin metal foil lead-in conductors into quartz envelopes. As shown, the quartz envelope 1 is provided with an exhaust tubulation 31 extending from one end and with a cylindrical neck portion 32 extending from its other end into which the lamp mount 27 is inserted and held in proper sealing relation, with the neck portion 32 of the envelope enclosing the etched tongue end portions 6, 6 and adjacent portions of the legs 3', 4' of the metal foil blank 10 and the inner wire leads or spuds 30. With the lamp mount 27 thus held in sealing relation within the envelope 1 and with the neck portion 32 of the latter extending downwardly, a flow of inert or reducing gas, for example nitrogen, is started into the open lower neck end 32 of the envelope in order to protect the filament 8 and the metal foil lead-in conductor blank 10 and wire inner leads 30 from oxidation, after which the neck portion 32 of the envelope is suitably heated, as by means of gas fires or flames 33 directed against opposite sides of the neck portion from gas burners 34 positioned thereadjacent. The gas fires 33 from the burners 34 are actually directed at the neck portion 32 of the envelope 1 in directions at right angles to those shown in FIG. 9, i.e., they are located at opposite sides of the plane containing the wire inner leads 30 and the leg portions 3', 4' of the foil blank 10. The neck portion 32 of the envelope is heated by the gas fires 33 to its softening point to cause it to collapse down onto and around the etched tongue end portions 6, 6 of the foil blank 10 and the adjacent portions of the legs 3', 4' thereof and the wire inner leads 30, whereupon the softened neck portion 32 is then compressed by a pair of more or less flat-faced pinch jaws 35, 36, as shown in FIG. 10, to form it into a flattened pinch seal 2 disposed flatwise with respect to the plane of the metal foil blank 10 and its two leg portions 3', 4'. The flow of nitrogen or other inert gas into the open lower neck end 32 of the envelope 1 is continued, during the sealing and pinching operation, until after the quartz of the pinch seal 2 has cooled to the point where oxidation of the metal foil blank 10 and filament 8 will not thereafter occur.

The sealed envelope and mount assembly 37 thus formed and shown in FIG. 10 is then transferred to conventional type lamp exhaust and gas-filling equipment in which the envelope 1 is then exhausted through the tubulation 31 and filled with the desired final gas filling, such as a mixture of argon and a small quantity of iodine. Thereupon, the exhaust tubulation 31 is sealed or tipped off, by directing gas fires 38 thereagainst from gas burners 39 as shown in FIG. 11, to leave an exhaust tip 40 on the envelope 1 hermetically sealing it from the surrounding atmosphere.

To complete the fabrication according to the invention of a lamp as shown in FIG. 12, the projecting outer end portion of the metal foil lead-in conductor blank 10 is then severed at its bight end 11, preferably along a transverse cutting line B (FIG. 11) thereof located just inwardly of the bight portion 11 of the foil blank 10, so as to cut off the entire bight portion therefrom and separate the blank 10 into two individual metal foil lead-in conductors 3 and 4 (FIG. 12) spaced apart from one another. The severing of the metal foil blank 10 into the two separate foil lead-in conductors 3, 4 may be performed at any time after the sealing of the lamp mount 27 into the envelope 1. Thus, it may be performed either before or after the exhausting and tipping off of the lamp envelope 1 as described above with reference to FIG. 11. It will be appreciated that instead of severing the foil blank 10 along a transverse cutting line B thereof as shown in FIG. 11 in order to separate it into two individual foil lead-in conductors 3, 4, the foil blank 10 alternatively may be severed for such purpose along a longitudinal medial centerline C thereof in alignment with the center slot 12 therein, in which case a narrow section of the foil blank 10, more or less corresponding in width to that of the slot 12, may be cut out of the blank 10 in order to afford adequate spacing apart of the two individual foil conductors 3, 4 to prevent electrical shorting therebetween during operation of the finished lamp.

The projecting outer end portions 5 (FIG. 12) of the two individual metal foil conductors 3, 4 formed by the severing of the foil blank 10 may themselves serve as the terminal contacts of the lamp (i.e., without the necessity of employing a separate lamp base mounted on the envelope 1), in which case they either may be left extending straight out endwise from the pinch seal 2 of the finished lamp as shown in FIG. 12, or they may be bent around either the same one of the flat sides of the pinch seal 2 or, as shown in FIGS. 13 and 14, around opposite ones of the flat sides of the pinch seal 2 so as to lie flat thereagainst.

From the above, it will be evident that I have provided an improved method for manufacturing single-ended electric incandescent lamps and similar devices of the type employing metal foil seals which enables the production thereof not only at materially reduced cost as compared to the prior lamps of such type which employed multipart metal foil lead-in conductor assemblies, but also with greatly increased facility and improved manufacturing controls such as results in a considerably more uniform and reliable end product. By sealing the metal foil lead-in conductors 3, 4 into the lamp envelope 1 while they are constituted as a single piece or blank 10 of metal foil, and while the filament is connected thereto and in place thereon, lamps with accurately prealigned and positioned filaments can be easily produced simply by holding the single-piece metal foil lead-in conductor blank 10 fixedly in place relative to the envelope in a suitable jig during the progress of the mount sealing-in operation. Moreover, failure of the seal and consequent premature failure of the lamp itself, due to corrosion of the outer welds in prior multipart-type metal foil lead-in conductor assemblies, is substantially eliminated in lamps employing metal foil seals according to the invention because of the absence of any such outer welds. As a result, not only is longer lamp life achieved with lamps made in accordance with the invention, but the lamps can be safely operated at considerably higher operating temperatures, and thus produce substantially higher light output than heretofore possible.

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

1. The method of making an electrical device comprising the steps of forming a metal foil lead-in conductor blank of U-shaped configuration having the free end portions only of its two legs etched to feather the edges thereof completely therearound, electrically connecting a filament to the tip ends of the etched leg end portions of said foil lead-in blank, fusing and pinch-sealing the neck end of an envelope of vitreous material around the etched leg end portions of said foil lead-in

blank to embed the said etched leg end portions thereof while leaving the bight end portion thereof projecting outwardly of the envelope from the pinch seal, and then severing the said foil lead-in blank at its bight end into two separate foil lead-in conductors spaced apart from one another.

2. The method of making an electrical device comprising the steps of forming a metal foil lead-in conductor blank of U-shaped configuration, electrolytically etching the free end portions only of the two legs of the said U-shaped foil lead-in blank to feather the edges thereof completely therearound, electrically connecting a filament to the tip ends of the etched leg end portions of said foil lead-in blank, fusing and pinch-sealing the neck end of an envelope of vitreous material around the etched leg end portions of said foil lead-in blank to embed the said etched leg end portions thereof while leaving the bight end portion thereof projecting outwardly of the envelope from the pinch seal, and then severing the said foil lead-in blank at its bight end into two separate foil lead-in conductors spaced apart from one another.

3. The method as set forth in claim 2 and comprising the added step of initially forming the said U-shaped foil lead-in conductor blank with a pair of opposed U-shaped notches in the side edges of each of its two leg portions and located a short distance inwardly from the tip ends thereof, and wherein the said electrolytic etching of the free end portions of the legs of the foil lead-in blank includes the portions thereof formed with the said notches.

4. The method as set forth in claim 1 and comprising the added step of folding the projecting outer end portions of the said foil lead-in conductors back around flat sides of the said pinch seal to lie flat thereagainst.

5. The method of making electrical devices comprising the steps of forming a metal foil ribbon with a series of transversely extending leg portions spaced apart along one edge thereof and having their free end portions only etched to feather the edges thereof completely therearound, transversely severing the said foil ribbon between alternate ones of the said leg por-

tions thereof to separate the ribbon into individual U-shaped foil lead-in conductor blanks, electrically connecting a filament to the tip ends of the etched leg end portions of one of said U-shaped foil lead-in blanks, fusing and pinch-sealing the neck end of an envelope of vitreous material around the etched leg end portions of said one foil lead-in blank to embed the said etched leg end portions thereof while leaving the bight portion thereof projecting outwardly of the envelope from the pinch seal, and then severing the said foil lead-in blank at its bight end into two separate foil lead-in conductors spaced apart from one another.

6. The method of making electrical devices comprising the steps of forming a metal foil ribbon with a series of transversely extending leg portions spaced apart along one edge thereof, electrolytically etching the free end portions only of the said leg portions to feather the edges of the said free leg end portions completely therearound, transversely severing the said foil ribbon between alternate ones of the said leg portions thereof to separate the ribbon into individual U-shaped foil lead-in conductor blanks, electrically connecting a filament to the tip ends of the etched leg end portions of one of said U-shaped foil lead-in blanks, fusing and pinch-sealing the neck end of an envelope of vitreous material around the etched leg end portions of said one foil lead-in blank to embed the said etched leg end portions thereof while leaving the bight portion thereof projecting outwardly of the envelope from the pinch seal, and then severing the said foil lead-in blank at its bight end into two separate foil lead-in conductors spaced apart from one another.

7. The method as set forth in claim 6 and comprising the added step of initially forming the said metal foil ribbon with opposed U-shaped notches in the side edges of each of its said leg portions and located a short distance inwardly from the tip ends thereof, and wherein the said electrolytic etching of the free end portions of the said leg portions of the metal foil ribbon includes the portions thereof formed with the said notches.

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