MANUFACTURE OF FOIL SEALS

8 Claims, 7 Drawing Figs.

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ABSTRACT: Molybdenum foils for pinch sealing into quartz are etched using shields which protect selected welding areas at each end from the action of the electrolyte. Etching provides feathered edges all around but leaves thicker areas under the shields to which the inleads and electrodes are welded without any need for extra tabs to facilitate welding or to increase the current-carrying capacity. In a preferred foil-inlead construction, the inlead and electrode have spade ends coextensive with the thicker areas in the foils to which they are welded.
MANUFACTURE OF FOIL SEALS

BACKGROUND OF THE INVENTION

The invention relates to foil or ribbon seals into vitreous envelopes of glass or quartz in lamp manufacturing. The high temperature required for softening quartz restricts the choice of metals available for sealing through it in practice to molybdenum and tungsten, both of which have coefficients of expansion much greater than quartz. To avoid cracking the quartz upon cooling, the conductor is shaped at least over the hermetically sealing portion as a thin ribbon or foil. The foil portion goes into tension without rupturing when the quartz cools and cracking or chalking of the foil is avoided.

For reliable sealing, a minimum ratio of about 100 to 1 between width and thickness is necessary in the foil and in the thicker foils there should be a taper angle not exceeding about 5° to the edges. Foils having such cross section can be obtained by rolling or etching. Longitudinally rolled one-piece molybdenum wire leads are described in U.S. Pat. No. 2,667,595—Noel et al. and are particularly suitable for lower currents. For higher currents or where heavier electrodes have to be supported by the foils during the dealing process, etched foils are preferred. An inlead conductor is welded to one end of the etched foil and an electrode or electrode support wire is welded to the other end.

SUMMARY OF THE INVENTION

In welding conductors to thin foil, frequently the foil is burnt through and a defect weld results. Also the current-carrying capacity of the combination is limited by that of the thin foil immediately next to the weld. The object of the invention is to provide a solution to these problems.

In accordance with my invention, etching of the foils is done in such a fashion as to leave a thicker region at each end of the foil to which the inlead and the electrode conductors are welded. This may conveniently be done by providing shielding means at each end of the foil to protect the selected areas from the action of the electrolyte. Electrolytic etching in an alkali solution thus provides feathered edges all around but leaves thicker regions or plates under the clamps. The inlead and the inner conductor which supports the electrode or energy translation element such as a filament may readily be welded to these thicker regions without any need for extra tabs to build up the thickness and facilitate welding or increase the current-carrying capacity.

In a preferred inlead-foil-electrode assembly for pinch sealing into a quartz envelope, the inlead and electrode ends next to the foil are spade shaped and match the thicker areas in the foils to which they are welded. This assures maximum strength and current-carrying capacity, and avoids foil sections projecting laterally into the quartz next to the welds which are too thick or insufficiently feathered to bond to the quartz.

DESCRIPTION OF DRAWING

FIG. 1 shows in partly schematic form a setup for electrolytic etching of foil according to the invention.

FIGS. 2a, b and c are respectively plan, longitudinal section, and transverse section views of etched foil according to the invention with the thickness shown exaggerated for ease of illustration. The sections are taken along the sections lines conventionally indicated.

FIGS. 3a and b show a welded inlead-foil-electrode assembly in plan and side views respectively.

FIG. 4 shows a complete discharge lamp with pinch seals utilizing etched foils in accordance with the invention.

DESCRIPTION OF PREFERRED EMBODIMENT AND PROCESS

A pinch seal having a current capacity of 50 amperes utilizes as starting material a molybdenum foil 0.0065 inches thick by three-fourths inches wide by 1 inch long. In accordance with the invention, the foil is electrolytically etched to provide feathered edges all around and thicker welding areas at both ends. This may be done in the apparatus illustrated in FIG. 1. The foil 1 is inserted between the legs of a springy metal clamp or holder 2 whose lower extremities are covered with thick insulating boots or shields 3 of flexible and resilient plastic material, suitably polyethylene. The plastic shields sit on the inside near their lower extremities so as to permit penetration by the molybdenum foil up to contact of the clamp by the edge of the foil. The plastic shields protect the portions of the foil which penetrate into the slits and the ends of the clamp 2 from the action of the electrolyte. The other electrode consists of a ring-shaped copper band 4 which is supported by a copper conductor 5 to which electrical connections are made. The molybdenum foil 1 and the ring electrode 4 are supported in the same plane in a basin 6 which is filled with the electrolyte, suitably a 20 percent solution of sodium hydroxide.

The use of alternating current for etching is preferred and a current of 25 to 50 amperes is suitable for the size of foil illustrated. Etching is most rapid at the edges and is a maximum at the corners of the foil. This causes the corners to become rounded and the edges to become feathered as illustrated in FIGS. 2a and 2c. However etching takes place all over except in the areas inserted into the slits 3 where the electrolyte does not have access to the foil. This results in thicker areas or plates 8, 9 at both ends of the foil which remain at the original thickness of 0.0065 inches. From the thicker areas, the thickness tapers gradually to that of the foil. Along the medial line of the foil, the thickness in the central part may be approximately half what it is at the thicker areas, as illustrated in FIG. 2b. Where the original thickness was 0.0065 inches, the thickness along the medial line after etching may be 0.0035 inches. The thickness tapers substantially to zero at the edges, except at the shoulders 10 of the thicker areas 8, 9 where the original foil thickness remains unchanged.

The etching process according to the invention results in a taper in thickness in the merging regions 8, 9 up to the welding plateaus 8, 9 which increases the current-carrying capacity. In foils not having this feature, it is in the region immediately around the weld points that excessive heating takes place and sets the limit on the current-carrying capacity of the foil. The tapering in thickness up to the welding plateaus in the foils prepared in accordance with my invention means that the limit in current capacity is set by the overall heating of the foil. Overall heating is determined by the cross-sectional area so that the current-carrying capacity is increased.

FIGS. 3a and b illustrate an inlead assembly utilizing the etched molybdenum foil 1 of the invention extending between a rodlike molybdenum inlead conductor 11 and a rodlike tungsten electrode 12. Both the inlead and electrode are spread or flattened at 11a, 12a, suitably by hot swaging, resulting in spade-shaped ends next to the foil. The spade ends match the thicker areas 8, 9 projecting at the ends of the foil and they are substantially coextensive in area. Thus after welding there are no sections of foil projecting laterally from the weld regions as at the shoulders 10 which are unetched or unfeathered and which would not bond properly and would cause weakness in the quartz.

To facilitate welding, the spade ends and thicker regions in the foil are first coated with a slurry of tungsten, molybdenum, and rhenium powders and fired in hydrogen. The parts are then pressed together and electric welded. The thickness of the spade ends is not critical because they do not seal to the quartz and 0.010 inches is convenient. In FIGS. 2b, 2c and 3b the thickness of the foil has been greatly exaggerated to permit illustration. The combination of spade ends on the inlead and electrode matching the thicker nonetched regions in the foils achieves maximum strength and current-carrying capacity. At the same time, weakness in the quartz from laterally projecting unfeathered sections which are incapable of bonding is avoided.

FIG. 4 illustrates a high-intensity compact source lamp 13 comprising a thick-walled quartz envelope 14 containing an
ionizable filling such as indium iodide. Etched foil inlead assemblies made according to the present invention are pinched sealed at 15 and 16 into the ends of the envelope and support anode and cathode 17 and 18 respectively. The use of etched foils according to the invention in the dimensions previously stated permits currents up to 50 amperes without overheating the seals.

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

1. An inlead-foil-electrode assembly for sealing into a vitreous envelope comprising a metal inlead, a thin metal foil and a metal electrode, said foil being etched all over and having feathered edges all around except for thicker areas at opposite ends tapering into the thickness of the foil adjoining it, said inlead and said electrode both having spade-shaped ends next to said foil, said thicker areas at the ends of said foil matching said spade-shaped ends and being substantially coextensive therewith and being welded thereto.

2. An assembly as defined in claim 1 wherein said thicker areas project at the ends of the foil without foil sections at the shoulders which are unfeathered and incapable of bonding to vitreous material.

3. An assembly as defined in claim 1 wherein the inlead consists of refractory metal, the foil consists of molybdenum, and the electrode consists of tungsten.

4. An electric device comprising a vitreous envelope having an inlead-foil-electrode assembly as defined in claim 1 sealed therein.

5. An inlead-foil-conductor assembly for sealing into a vitreous envelope comprising a metal inlead, a thin metal foil and a metal inner conductor, said foil being etched all over and having feathered edges all around except for thicker unetched areas at opposite ends, said thicker areas tapering into the etched foil adjoining it, said inlead and said inner conductor being welded to said thicker areas.

6. An assembly as defined in claim 5 wherein said thicker areas project at the ends of the foil without foil sections at the shoulders which are unfeathered and incapable of bonding to vitreous material.

7. An assembly as defined in claim 1 wherein the inlead consists of refractory metal, the foil consists of molybdenum, and the inner conductor consists of tungsten.

8. An electric device comprising a vitreous envelope having an inlead-foil-conductor assembly as defined in claim 5 sealed therein.