A high intensity ultraviolet lamp is provided in the form of a quartz envelope having at each end a neck of reduced diameter retaining a pair of leads connected on the interior of the main body of the envelope with a filament; and a method for producing the lamp by reducing the ends of a quartz tubular envelope to provide a relatively thin neck at each end and fusing onto the end of each neck an electrode assembly comprising filament leads and a filament.

5 Claims, 3 Drawing Figures
HIGH INTENSITY ULTRAVIOLET LAMP AND METHOD FOR PRODUCING THE SAME

BACKGROUND OF THE INVENTION

The use of radiation in the ultraviolet region of the spectrum has become increasingly more important as a means for controlling microorganisms in many areas. Indeed, ultraviolet lamps are used extensively to create sterile conditions in the pharmaceutical industry, the food industry in hospitals for sterilization of medical and dental equipment, in the purification of water, and many other applications.

With the increasing demand for devices capable of meeting these various industrial applications of ultraviolet radiation has come a corresponding demand for higher intensity devices which are capable of emitting more ultra-violet radiation per unit than heretofore available. This applies primarily to the use of germicidal lamps, although it is well-known that ultraviolet radiation has many other uses, for example in the chemical field as well.

The conventional germicidal lamp has many similarities to a normal fluorescent lamp, the principal difference being that the envelope is not provided with a fluorescent coating, and that the envelope is constructed of special glass favoring the maximum transmission of radiation in the ultraviolet region, at about 2537 A, of the spectrum. The tube usually consists of quartz glass or glass having a high silica content such as that sold under the trademark “Vycor”, which is capable of maximum transmission of the ultraviolet light generated by discharge between two opposed electrodes of an ionized gas comprising a mixture of mercury vapor and an inert gas, such as argon, at low pressure.

The general practice in the manufacture of ultraviolet lamps involves fusing the current-carrying leads for the electrode directly onto the end of a tubular quartz envelope. While this technique has been found to be substantially acceptable in the fabrication of small lamps of low intensity, of say about 15 watts ultraviolet output and below, difficulties are encountered if the production of higher intensity lamps with greater dimensions are attempted in accordance with such prior art construction.

In particular, the inherent requirement for quartz or like glass construction of the tube necessitates the use of extraordinarily high temperatures, in the order of 3250°F, for fusing the electrode leads directly to the quartz tube. This becomes increasingly more difficult as the dimensions become larger, since the heat required at larger dimensions often results in destruction of the lead-in wires, if not the electrode filament itself.

SUMMARY OF THE INVENTION

In accordance with the present invention, a new form of ultraviolet lamp is provided which is capable of emitting an output of 50 watts and above in the germicidal ultraviolet region of the Spectrum (about 2537 A), and a method for producing the same.

This is accomplished by a unique structure and method of fabrication which facilitates the use of relatively large diameter quartz or silica tubes and at the same time protects the lead-in wires and electrode against thermal degradation or destruction during the fusing operation required to affix the electrode assembly and filament and position the same within the tube.

More specifically, the glass tube is provided at each end with an integral neck of substantially reduced diameter by thermally reducing the main body of the tube itself to form at each end a tubular extension of say 10 to 20 mm in outer diameter and a wall thickness of from about 1 to 2 mm. The size of the main body of the envelope may vary from about 1 to 2 inches in outer diameter, and higher if desired, with wall thicknesses of from about 1 to 3 mm. The length of the envelope at these dimensions is quite variable, from 20 to 96 inches in overall length being suitable for most purposes.

One purpose of the neck or tubular extension is to provide a relatively small diameter body for affixing, by thermal fusion, the electrode leads directly to the end thereof for or for affixing a further glass body or collar of like diameter which retains filament leads and a filament. The further glass body, which may also be quartz but can be glass of other composition, such as high silica glass, is preferably in the form of a short tube of sufficient length so that, taken with the length of the reduced neck, there is formed a significant “cold spot” region behind the filament to promote partial condensation of the mercury vapor within the tube and thereby inhibit the development of high vapor pressures which reduce lamp efficiency. For this purpose it has been found advantageous if the length of the neck is at least about twice the outer diameter of the neck, whether a one piece extension of the main body is used or an extension thereof with a collar fused thereto.

To protect the filament lead-in wires against oxidation, distortion and disintegration, from the heat required for fusion of the reduced neck to the collar, the filament leads are preferably each covered by a thin tube of quartz or high silica glass, although these may not be necessary in some circumstances when the aforesaid neck extension is formed of one rather than two pieces of glass.

By such means as described, it becomes possible to utilize much larger tubular envelopes for the construction of higher intensity lamps and yet complete the assembly thereof with little or no more heat than required in the fabrication of small lamps.

The invention will be more fully understood by reference to the following more detailed description of the preferred embodiment and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a complete lamp constructed in accordance with this invention;

FIG. 2 is a view, partly in section, of one end of the lamp of FIG. 1, minus the plastic end connector; and

FIG. 3 is a view, partly in section, of the end shown in FIG. 2, but rotated 90° from the view shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, 1 is a cylindrical tube composed of quartz glass or similar material which favors the maximum transmission of ultraviolet light. The ends of cylindrical tube 1 are tapered downwardly to form neck extensions 3 and 3′ of reduced diameter for receiving electrode leads shown in FIGS. 2 and 3 and provided with plastic caps 5 and 5′ covering said leads and electrically connecting the same with suitable
prongs 7 and 7' or other means for connecting the lamp at each end to a source of electric power. For ready reference only one end of the lamp will be described in detail.

Neck extensions 3 and 3', as shown in FIGS. 2 and 3, are fused at 4 to a prefabricated cylindrical glass tube or collar 9, preferably of high silica content, and substantially equal to the diameter and thickness of extension 3. Collar 9 is flattened under heat at 11 to retain two electrode leads 13 and 15 which are preferably composed of molybdenum or tungsten. Leads 13 and 15 are conveniently spot welded to thin strips 17 and 19, respectively, which may be composed of molybdenum foil, prior to compression of the glass at 11; and external leads 21 and 23 of molybdenum are also spot welded to strips 17 and 19 for connection with a source of power through plastic cap 5 and 5' and prongs 7 and 7'.

Leads 13 and 15 are in turn spot welded to filament retaining leads 25 and 27, respectively, the latter preferably constructed of nickel-plated, iron wire. Leads 25 and 27 retain the filament 29 by crimping said leads around each end of filament 29 or by other suitable means. Filament 29 is preferably composed of tungsten and coated with a mixture of Ba-Sr-Ca oxides in a conventional manner. Leads 25 and 27 are advantageously spaced apart by a mica separator 28 which holds the same firmly in place.

In order to fabricate a tube of such high intensity, it has been found advantageous not only to extend and narrow the tube at the neck 3, but also to protect the leads 13 and 15 from oxidation, distortion or destruction by the high temperatures required to fuse collar 9 to neck 3. This is accomplished by means of protective high silica or quartz tubes 31 and 33 of sufficient diameter to provide a close but friction-free fit about each of leads 13 and 15, which thereby isolate the metallic leads from the deleterious effects of the heat required for fusion of the glass as described and without destruction of the filament leads or the filament itself.

During the fusion of collar 9 to neck 3, it is important to apply to the interior of the assembly air or nitrogen at a pressure sufficient to prevent components 9 and 3 from collapsing at the point of fusion. This may be accomplished by introducing air through the open end of neck 3 while the opposing neck 3' is being fused to a corresponding collar (not shown); and thereafter, introducing air into the assembly shown in FIGS. 2 and 3 through a port 35 through a small glass tube (not shown) fused to the port, while rotating the assembly in a flame applied to the point of fusion.

Port 35 is also later employed for excavation and filling of the lamp in a conventional manner, upon completion of which it is fused closed.

The prefabrication of collar 9 which carries the electrode assembly may be carried out in several ways. One method comprises spot welding together elements 13, 17, 21 and elements 15, 19 and 23 and placing the same in a suitable jig, then preheating in a remote location one end of a glass tube which is to form the collar 9 assembly. When the end of the tube has become sufficiently plastic to form a seal the tube is rapidly advanced over the lead assemblies and compressed to form a flattened seal at 11. The electrode assembly is then completed as shown in FIGS. 2 and 3.

Another method for fabricating the collar 9 assembly is to place the electrode leads, and indeed the entire electrode assembly in a jig surrounded by a glass tube of the diameter of collar 9, heat the end of the tube by application of flame to the exterior thereof, while passing cool inert gas such as argon or nitrogen through the interior of the tube to protect the leads, and finally compress the end of the tube to form the flattened seal 11 after the glass has reached the plastic state.

In accordance with another embodiment the use of collar 9 is dispensed with and the electrode assembly is affixed directly to reduced necks 3 and 3' of tube 1. In such event protective glass tubes 31 and 33 may not be essential, but can be used if desired. When such direct attachment is adopted, similar methods of fabrication as described above may be employed. For example, the ends 3 and 3' may be preheated in a remote location, then advanced successively over the electrodes and compressed about the base of the leads as shown. In this case, however, it is necessary to advance the necks 3 and 3' over the completed electrode assemblies, which must be performed with considerable care.

Necks 3 and 3' may also be affixed directly to the electrode assemblies by applying flame to each end of the extensions or necks with the completed electrode assemblies in place, while passing cool inert gas such as argon or nitrogen through the interior of the tube, and then compressing the ends of the necks about the lead-in wires.

In view of the foregoing, it will be understood that in the past the amount of heat required to fabricate a high intensity ultraviolet lamp was substantially in proportion to the intensity and size of the lamp desired. Bearing in mind the high temperatures required to fuse quartz and similar glass, the present invention provides a method for fabrication of such high intensity lamps which overcomes this problem. More specifically, it has been found that the relative dimensions of the lamp, in relation of the temperature and heat required for such fabrication, are quite important when applied to conventional lamps. However, according to the present invention, the dimension of the main body of the gas envelope or tube 1 per se no longer is a critical factor, since any tube within reasonable size may be reduced to provide a neck 3 of relatively small diameter, the lamp which the electrode leads may be affixed. Moreover, it is not to be excluded that the collar 9 may be omitted and the leads affixed directly to necks 3 and 3' in other embodiments of the invention, as previously set forth.

It is, on the other hand, advantageous that the relative dimensions of the neck 3 and collar 9 be such that the location of the fusion point 4 between collar 9 and neck 3 is at about the middle of the extension formed by collar 9 and neck 3; that the filament leads 13 and 15 together with leads 25 and 27 extend at least up to the end of neck 3 where it becomes the main body of tube 1; and the quartz tubes 31 and 33 cover substantially the length of molybdenum leads 13 and 15; all thereby minimizing the possibility of adverse heat damage during fabrication.

Finally, it is again to be noted that the resulting structure of this invention provides, by virtue of the elongated mounting of the filament through neck 3 and collar 9, a more pronounced "cold spot" in the lamp than is obtained through conventional construction, thereby conferring operational advantages not heretofore obtained.
Resort may be had to such modifications and equivalents as fall within the spirit of the invention and the scope of the appended claims.

What we claim is:

1. A high intensity ultraviolet lamp comprising a high silica content, tubular glass envelope having at each end a neck of reduced diameter compressed on the end to form a seal retaining a pair of leads connected on the interior of said envelope with an electrode filament, said filament being situated at about the entrance to the main body of said envelope, and an ionizable gas within said envelope capable of producing ultraviolet light upon electrical energization of said gas.

2. A lamp according to claim 1, where the length of said neck is about twice the outer diameter thereof to provide a significant cold spot behind the electrode filament.

3. A lamp according to claim 1, wherein each of said leads is protected by a small high-silica content glass tube overlying the same and extending from about the seal of each lead to about the entrance to the main body of said envelope.

4. A lamp according to claim 1 wherein said neck is fused to a collar retaining said leads and each of said leads is protected by a small high-silica content glass tube positioned to cover said leads at the point of fusion.

5. A lamp according to claim 4, wherein the point of fusion of said neck and collar is at about the middle of the reduced diameter formed by said neck and said collar.

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