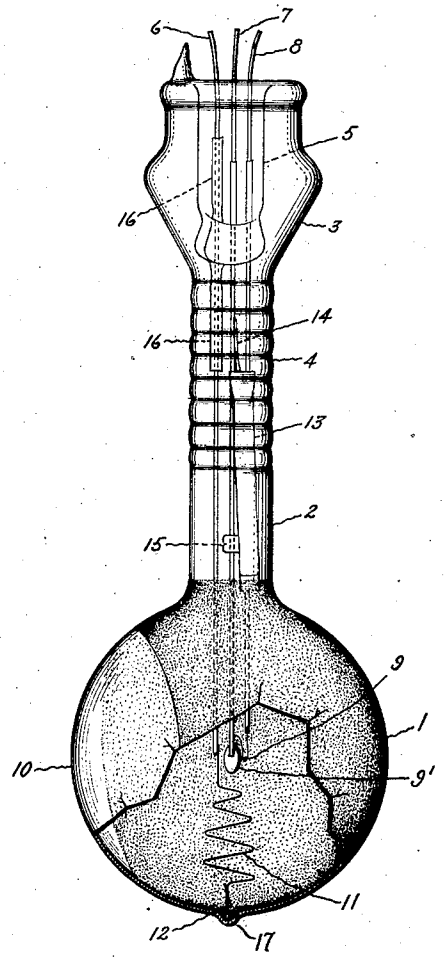
April 5, 1932. P. J. JOHNSTON 1,852,808

PHOTO ELECTRIC TUBE

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UNITED STATES PATENT OFFICE

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PHOTO-ELECTRIC TUBE

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The present invention relates to apparatus sensitive to light and more particularly to photo-electric tubes responsive to light of wave lengths less than those of the visible spectrum, e. g., in the ultra violet region, between 2000 and 4000 angstroms. Rays of this sort are obtained from specially constructed lamps of well known design and may be employed for sterilizing and for promoting chemical and physical actions in liquid and solid substances. In the employment of ultra violet light, it is often desirable to measure its intensity which necessitates utilizing a device quantitatively responsive to the rays. It is known that certain of the alkali metals are affected by light, including ultra-violet, but when this material is incorporated in a bulb made of glass as in the ordinary photo-electric tube construction, the glass absorbs the rays to such an extent as to preclude their transmission in a large degree toward the light sensitive material. Quartz is one of the few substances highly transparent to ultra violet light but attempts to fabricate photo-electric tubes of this material have not heretofore been entirely successful commercially due chiefly to the difficulty of making in quantity electrical connection with the light sensitive layer positioned within the tube. In order to make such connection, it is necessary to fuse or otherwise secure the leading-in conductor to the interior surface of the envelope and in view of the exceedingly high melting temperature of quartz (2200° C.) this has been found to be heretofore an impractical task.

An object of the present invention is to provide a photo-electric tube having a quartz envelope to the interior of which a rigid connection is made in order to contact with the light sensitive material. A more general object is to devise apparatus which will efficiently translate light energy of all wave lengths including the wave lengths which lie between 2000 and 4000 angstroms into electrical energy suitable for measurement purposes. These objects are attained in brief by providing a compression spring in the leading-in conductor which contacts with the light sensitive layer so as to force the conductor continually against the surface of the quartz. It has been found that when the envelope is heated exteriorly at a position corresponding to the place of contact between the conductor and envelope on the interior, a rigid connection is formed between these members. The invention will be better understood when reference is made to the drawing in which the figure represents a view in elevation, partly broken away, of the improved photo-electric tube.

Referring to the drawing, numeral 1 indicates an evacuated bulb of quartz or other material pervious to ultra violet light and provided with a neck portion 2. A member 3, preferably of hard glass and suitable for forming a hermetic seal on the pump is attached to the bulb 1 by means of a graded seal 4 of well known construction. The member 3 terminates in a reentrant stem 5 into which are sealed conductors 6, 7 and 8. Between the conductors 7 and 8 there is a filament 9 constituted of silver or other suitable metal which is adapted to be evaporated when heated by current, the silver vapor spreading over and condensing on the interior surface of the bulb. The conductor 7 carries a metal disc 9′ which prevents deposition of the silver on that portion of the bulb in the rear of the disc, providing in this manner a window 10 for the admission of light.

In order to effect a connection with the quartz envelope and with the silver or other metallic surface when formed, the conductor 6 is provided in accordance with my invention, with a compression spring 11 which carries at the end in contact with the envelope a short piece of platinum wire 12. The platinum member is secured rigidly to the interior surface of the envelope by simply playing a hot flame, obtained for example from a "quartz burner" so-called, on the exterior of the bulb directly below the point of contact. It is found that a portion of the platinum wire melts into a ball or other shape of large surface and under the compressional force exerted by the spring 11 adheres tenaciously to the interior of the envelope making a rigid contact with the envelope. The combined effect of the heat and the force exer-

cised by the spring against the wall may produce a small depression in the bulb as indicated at 17. Heretofore it has been found impossible to form a rigid contact between a metal wire and a body of quartz on account of the difficulty of melting or fusing quartz and at the same time positioning the leading-in conductor rigidly in place within the bulb. While the exact nature of the joint obtained in this manner is not completely understood, I believe that it is due partly to an extraordinary high surface tension acquired during the localized heating and perhaps a slight penetration of wire into the quartz. Whatever be the correct explanation, I have discovered that a contact made in this manner is positively rigid and reproducible and is entirely practical in construction and operation.

After the silver or other metal has been deposited on the inner walls of the bulb portion including the junction between the platinum wire and the quartz, a highly reactive metal such as lithium or sodium may be introduced into the tube. The reactive material is preferably provided in a metal tube 13 which may be attached to one of the conductors by a piece of stiff wire 14 and a support 15. The tube 13 is pinched at both ends and at the end to which the wire is secured is also welded. Before the tube 13 is closed, and prior to its insertion into the envelope, the reactive material is introduced therein together with a binder such as aluminum, magnesium or calcium. When the alkali-containing tube is in position, high frequency currents may be induced therein from an exteriorly positioned coil (not shown) and the alkali vapor caused to distill through the end of the tube which is not welded, thereby to condense on the silver layer. In order to prevent current leakage between the leading-in conductors at the place where they emerge from the reentrant stem due to the condensation of alkali vapor at this place, a glass tube 16 may be fitted about one of the conductors to increase the insulation distance. If desired, an inert gas such as argon at a pressure of about 75 microns of mercury may be admitted into the envelope.

In operation, a voltage is applied between the conductors 6 and 7 and when ultra violet or other light having a wave length shorter than that of the visible spectrum is allowed to impinge on the alkali metal layer through the window 10, the impedance of the photo-electric tube is lowered in a degree corresponding to the intensity of the light. While the utility of the quartz photo-electric tube has been described in connection with light having wave lengths below the visible spectrum, it will be apparent that the device may also be employed in the measurement of light of other frequencies.

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

1. A photo-electric tube comprising an envelope of quartz provided with an interior layer of a light-sensitive material, an electrode cooperating therewith and a leading-in conductor for said material, said conductor being rigidly joined to the interior surface of the quartz envelope.

2. A photo-electric tube comprising an envelope of quartz provided with an interior layer of light-sensitive material, an electrode cooperating therewith and a leading-in conductor for said material, said conductor being fused to the quartz.

3. A photo-electric tube comprising an evacuated envelope of quartz containing a light-sensitive electrode and a cooperating electrode, a pair of conductors passing through the envelope and connected with the electrodes, and means for forcing the conductor connected with the light-sensitive electrode against the inner surface of the envelope whereby the conductor may be secured to the envelope at the place of contact.

4. A photo-electric tube comprising an evacuated envelope of quartz containing a light-sensitive electrode and a cooperating electrode, a pair of conductors passing through the envelope to furnish connection with the electrodes, and means for forcing the conductor connected with the light-sensitive electrode against the interior surface of the envelope whereby the conductor may be secured to the envelope at the place of contact, said means comprising a compressional spring interposed in the said conductor.

5. A photo-electric tube comprising an evacuated envelope of quartz containing a light-sensitive electrode and a cooperating electrode, a pair of conductors passing through the envelope and connected with the electrodes, spring means for forcing the conductor connected with the light-sensitive electrode against the interior surface of the envelope, and means for rigidly joining the conductor with the quartz at the place of contact.

6. The method of securing a metallic wire to a quartz member which consists in forcing the wire lengthwise against the said member and heating the opposite surface of the quartz member at a position corresponding to the place of contact while maintaining the force on the wire until the latter is secured to the quartz member.

In witness whereof I have hereunto set my hand this 31st day of January, 1930.

PHILIP J. JOHNSTON.