

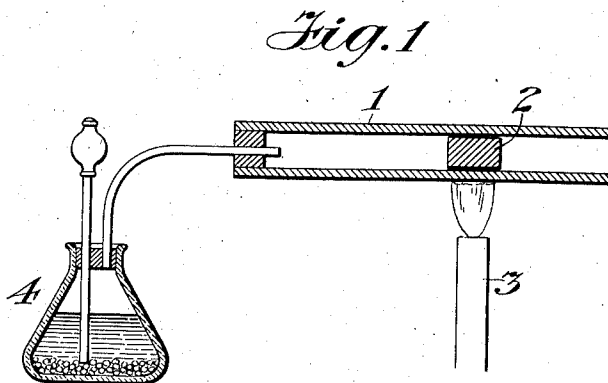
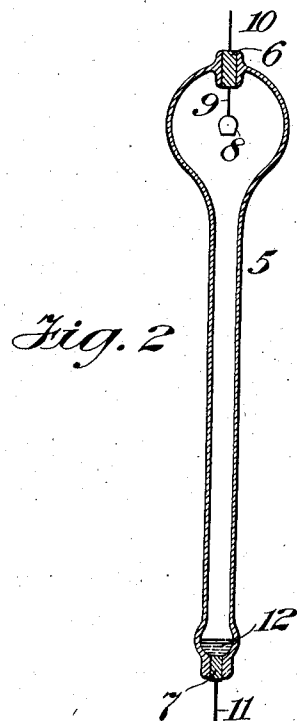
No. 866,301.

PATENTED SEPT. 17, 1907.

H. N. POTTER.

METHOD OF FORMING SEALS AND TERMINALS FOR ELECTRIC APPARATUS.

APPLICATION FILED NOV. 19, 1903.



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UNITED STATES PATENT OFFICE.

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METHOD OF FORMING SEALS AND TERMINALS FOR ELECTRIC APPARATUS.

No. 866,301.

Specification of Letters Patent.

Patented Sept. 17, 1907.

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To all whom it may concern:

Be it known that I, HENRY NOEL POTTER, a citizen of the United States, and a resident of New Rochelle, county of Westchester, State of New York, have invented certain new and useful Improvements in Methods of Forming Seals and Terminals for Electric Apparatus, of which the following is a specification.

It has heretofore been proposed to employ quartz as an inclosing chamber for various electrical and other devices wherein its chemical and optical properties render it more advantageous than glass. One difficulty in the use of such material for such purposes has been that no electric conductor has hitherto been found which will form therewith a tight seal or conductor for leading electric current through the walls of the chamber. The nearest approach to this has been with metallic iridium which is refractory enough but which has an expansion coefficient differing sufficiently from quartz to prevent the seal remaining tight when cooled to ordinary temperatures. A seal made of iridium requires in addition an application of shellac or similar material to render it tight and consequently a vessel so made could not be heated in the region of the seal to temperatures sufficiently high to adapt it for many uses, especially for those which require a permanent high vacuum or a vapor existing at high temperatures, and for various other reasons such a seal has been found impracticable for permanent uses.

I have discovered that silicon in its so-called metallic state has all the properties which adapt it for use as a seal in quartz vessels, and that with metallic silicon such seals can be made which are tight and by means of which current can be caused to pass through the wall of the vessel in practical quantities, and which seals are not injured by being heated to a red heat or even higher. The expansion coefficient of metallic silicon seems to be approximately that of silica. It is further not oxidizable even at a white heat in the absence of such gases as carbon dioxide, for instance.

In practice I find an excellent way is to produce the metallic silicon in the form of a round rod or wire which can be readily done by grinding on an emery wheel, and slipping the said rod within a tube of quartz so that the quartz tube projects beyond the rod of silicon. If then, the quartz be heated externally opposite the silicon rod in an oxy-hydrogen flame, the rod can be caused to melt and it will then wet and adhere to the silica and will not separate from the latter when cooling. If it is further desired to expose the silicon the silica may then be removed by grinding or any other appropriate way and contact made with the silicon either by welding directly to platinum, or by dipping in mercury, or in any other appropriate manner. Should any slight oxidation occur on the inner surface of the silicon seal, preventing its making good electrical contact with the

mercury or other conducting material within the vessel, the slight coating of oxid can be readily removed by dissolving in very dilute hydrofluoric acid. This acid will, of course, also attack the vessel of quartz, but the oxid film is so extremely thin as to be iridescent and it is almost instantly removed, so that the injury to the quartz vessel is negligible.

In case it is desired to produce the seal without the slightest danger of oxidation or a combination with any flame gases which may enter the tube, I find it entirely practicable to pass a slow current of inert gas such as hydrogen through the vessel during the period when the seal is being formed. This insures that the silicon is surrounded with an inert gas up to the instant of wetting the silica and also that the inner end of the silicon shall remain unchanged.

Metallic silicon is a good conductor of electricity of about the order of carbon, but has an advantage over carbon in that it is not porous; that it can be melted and cast into convenient preliminary shapes; that it does not oxidize in air, even at white heat, and that it can be fused directly to platinum and other metals. In the case of metals likely to oxidize, a flux such as borax may be used with success. It is advantageous, however, to select as a metal one having a small coefficient of expansion with change of temperature. I have found a good material to be nickel steel containing approximately 36.4 per cent of nickel, this material having the least known coefficient of expansion among metals and being known as the Guillaume alloy.

I may mention as one very important use of this invention the application of it to the so-called Cooper Hewitt vapor lamps and other vapor devices. In the case of a lamp, the use of quartz is advantageous in that the latter is transparent to ultra-violet rays which have valuable therapeutic and other properties and for which glass is opaque. Further, lamps constructed of quartz can be operated at temperatures which are not permissible with glass of any kind, and, therefore, metals other than mercury may be readily used as a source of conducting vapor. Further, the quartz is more inert to chemical attack than glass, and such metals as antimony, bismuth and lead in a melted or gaseous state do not attack quartz. There is also an advantage in the use of quartz for mercury vapor devices in that the current density can be pushed far beyond what is possible in glass with attendant advantages.

In the accompanying drawings which illustrates an application of the invention; Figure 1 shows a process of sealing the silicon to the quartz, and Fig. 2 illustrates an application of the invention to a Cooper Hewitt mercury vapor lamp.

Referring to the drawings, 1 represents a quartz tube; 2 represents a plug of silicon inserted loosely therein; 3

represents a source of heat of any suitable character, such, for instance, as an oxy-hydrogen flame. A source of inert gas, such as hydrogen, is illustrated at 4. This gas is passed through the tube 1, while sufficient heat is applied to melt the silicon and fuse it to the silica. It should be stated, however, that the process of passing the inert gas through the tube is not essential.

In Fig. 2, 5 represents the wall of a mercury vapor lamp composed of silica or quartz. 6 and 7 represent leading-in conductors of silicon; 8 represents a solid electrode of any suitable character, which is here shown as being attached to the inner surface of the leading-in conductor 6 by a conductor 9. An exterior conductor, 10, is likewise fastened to the exterior surface of the leading-in conductor 6. These two conductors may be of platinum, nickel steel, or other suitable material and fused directly to the silicon. In like manner, the conductor 11 may be sealed to the leading-in conductor 7, and at 12 I have illustrated a small quantity of mercury or other fluid conductor from which the vapor conductor is derived.

It will be understood from what has been herein

stated that other materials than mercury may be employed in this chamber for affording a conducting path.

In a divisional application filed on the 11th day of January, 1904, claims are made upon the apparatus herein.

I claim as my invention:

1. The method of forming a seal between metallic silicon and quartz glass, which consists in fusing the former within the latter. 30
2. The method of producing a leading-in conductor for electrical devices, which consists in fusing into the walls of a quartz glass chamber a section of silicon.
3. The method of fusing silicon to silica, which consists in heating the joint to a temperature sufficient to fuse the silicon in an inert gas. 35
4. The method of sealing silicon within a tube of silica, which consists in passing an inert gas through the tube, and fusing the silicon out of contact with gases active relative to it. 40

Signed at New York, in the county of New York, and State of New York, this eighteenth day of November, A. D. 1903.

HENRY NOEL POTTER.

Witnesses:

WM. H. CAPEL.

GEORGE H. STOCKBRIDGE.