(No Model.)

T. A. EDISON.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

No. 438,307. Patented Oct. 14, 1890.

Fig. 1.

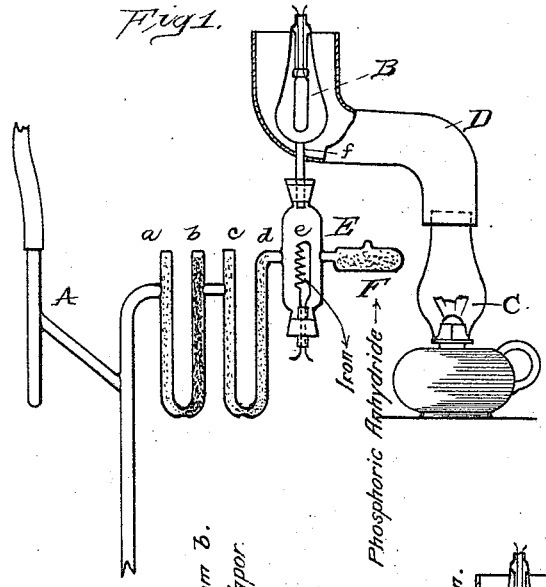


Fig. 3.

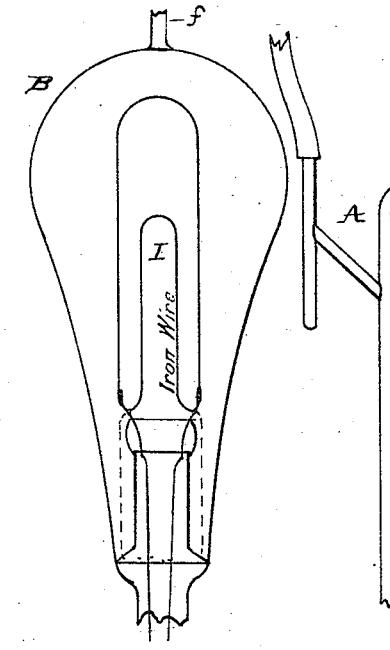
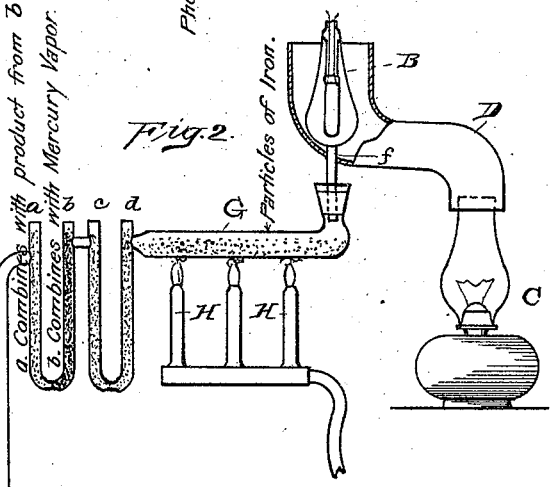


Fig. 2.



ATTEST:

E. C. Rowland

H. W. Pelzer.

INVENTOR:

Thomas A. Edison,

By Dyer & Seely

Attys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 438,307, dated October 14, 1890.

Application filed July 17, 1886. Serial No. 208,245. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Processes of Manufacturing Incandescent Electric Lamps, (Case No. 669,) of which the following is a specification.

The object of my invention is to produce in the inclosing-globe of an incandescent electric lamp a high vacuum free from mercury-vapors and from moisture and watery vapors.

The process of exhaustion heretofore followed in the manufacture of these lamps is by the use of a Sprengel mercury-vacuum pump, and during the operation of exhaustion by the pump the carbon filament of the lamp is heated to very high incandescence, the object of such heating being to expel certain gases and vapors which were supposed to be "occluded" or contained in the pores of the carbon. I have found that in the operation of the pump vapors of mercury pass therefrom to the lamp, where they remain, leaving an atmosphere due to the vapor tension of mercury instead of the very high vacuum which is essential for very long life and high economy in use of the lamp. I have also found that the amount of gases occluded in the carbon filament is so small as to be of no practical consequence in impairing the vacuum, but that the fluids expelled from the lamp by heating the filament came, not from the filament itself, but from the inner surface of the glass of the globe, where such fluids adhere until driven off by heat. The heating of the filament then served to heat the glass, so as to drive off its gases and vapors, and it is this that makes it necessary to bring the filament to such a very high incandescence, higher than that at which it is intended to be brought in use. Such extreme heating of course may affect the carbon injuriously in some cases, and tends, also, to diminish the length of time for which it can be used.

My invention then relates, first, to a method and apparatus for preventing the mercury-vapors from entering the globe, and, second, to a method and apparatus for removing the moisture and watery vapors from the globe, these methods and apparatuses being each a part of the complete process and apparatus whose aim is to produce, as nearly as possible, a perfect vacuum in the lamp-globe.

Apparatus embodying my invention is illustrated in the accompanying drawings.

Figure 1 is a view in elevation of complete apparatus embodying said invention; Fig. 2, a similar view with a different arrangement for getting rid of the moisture, and Fig. 3 a view of a lamp provided with still other means for this purpose.

Referring to Figs. 1 and 2, A is a Sprengel pump. *a b c d* are tubes or receptacles situated between the pump and the lamp B which is to be exhausted. C is a heating-lamp, from whose chimney a metal tube D extends, which surrounds the electric lamp B, having an aperture for the exhaust-tube thereof.

In Fig. 1, E is a chamber, in which is placed a spiral of iron wire *e*, having electrical circuit-connections to enable it to be heated to incandescence. F is a bulb containing phosphoric anhydride or other moisture absorbent, which may be used, if desired.

Tube *b* contains a substance which is an absorbent of mercury-vapors, or which combines chemically with such vapors. I prefer to use iodine, chlorine, or bromine, or an iodide, chloride, or bromide.

Tubes *a*, *c*, and *d* contain a substance which absorbs or combines chemically with gases or vapors arising from the substance contained in *b*. In the case of iodine in *b* antimony or bismuth may be placed in the tubes on either side thereof, or quicklime may be used in the case of chlorine or bromine. A salt of iodine may be used in *b*, which gradually gives off vapors of iodine, or a chloride which gives off free chlorine gradually, or a chloride that gives off its chlorine slowly by a gentle heat, (which may be applied to the exterior of the tube,) such as sesquichloride of chromium. An inert porous material, like charcoal, saturated with chlorine or equivalent gas, may be employed.

In *a c d* other substances than those above named may be used—such as metals, as copper, zinc, and iron—which combine with chlorine; or absorbent substances may be used, as oxides, magnesia, charcoal, and other inert substances which absorb gases in their pores.

The pump A being in operation, the mer-

cury-vapor which flows therefrom toward the lamp is absorbed by or combines with the substances in *b* and is thus prevented from reaching the lamp. The vapors or gases from *b* are on the one hand stopped by the substance in *a* from reaching the fall-tube of the pump, where they would combine with the mercury and injuriously affect the pump's operation. On the other hand, such gases and vapors are prevented by the substance in *c* and *d* from reaching the lamp, where they would impair the vacuum. At the same time the heat from lamp C passes up around the electric lamp B and heats the glass thereof, so as to drive off the gases and vapors, principally watery vapors, which adhere thereto. Some of these gases are immediately drawn off by the pump. The water is either absorbed by the phosphoric anhydride or is decomposed by the iron spiral into its elements, the oxygen combining with the iron, while the hydrogen, owing to its great mobility, is readily removed by the pump.

Instead of heating the iron by the electric current, the arrangement shown in Fig. 2 may be employed. The receptacle G contains particles of iron or other suitable metal, and these are heated by gas or other burners H, so that they decompose the water and take up its oxygen, as just explained; or the arrangement seen in Fig. 3 may be used. Here the lamp has a small iron-wire loop I placed within it, the ends of the wire being twisted around or otherwise attached to the copper leading-in wires. Current being passed through the lamp, the iron is heated to incandescence and the effect on the water in the lamp is the same as before. The heating is then continued until the wire breaks at some point, after which a magnet is applied to the outside of the lamp and the two parts of the wire are drawn apart down into the bottom of the lamp, where they remain after the lamp is sealed, as shown by the dotted lines.

All these operations having been finished and the lamp being exhausted to a very high vacuum free from mercury-vapor and from moisture, it is sealed off from the pump at *f*, and is then ready for use.

I do not claim herein heating the lamp externally to drive off the vapors and gases from the glass during the exhausting process, since this is claimed in my patent, No. 411,018, dated September 18, 1889; neither do I claim the lamp provided with a non-mercurial high vacuum, since this is claimed in my Patent No. 411,018, dated Sept. 18, 1889; neither do I claim the special devices illustrated in Figs. 2 and 3; but I reserve these for other applications.

What I claim is—

1. The within-described improvement in the method of exhausting incandescent electric lamps by mercury-pumps, which consists in taking up the vapors from the pump by a material placed between the pump and the lamp and taking up the gas or vapor from such material by other materials.

2. The within-described improvement in the method of exhausting incandescent electric lamps by mercury-pumps, which consists in heating the lamp to remove the gas and vapor therefrom and decomposing the watery vapor, its hydrogen being removed by the pump and its oxygen taken up by material provided for the purpose.

3. The combination, with a Sprengel pump for exhausting an incandescent electric lamp, of a material situated between the pump and the lamp capable of absorbing or combining with mercury-vapors, and a material capable of absorbing or combining with the gas or vapors arising from such mercury-absorbing material, substantially as set forth.

4. The combination, with a Sprengel pump for exhausting an incandescent electric lamp, of means for heating the lamp, and a material for decomposing the watery vapors expelled from the lamp by such heating, substantially as set forth.

5. The combination, with a Sprengel pump for exhausting an incandescent electric lamp, of iron in a chamber or receptacle connected with the lamp, means for heating the lamp, and means for heating the iron, substantially as set forth.

6. The within-described improvement in the method of exhausting incandescent electric lamps by mercury-pumps, which consists in taking up the vapors from said pump by a material placed between the pump and the lamp, heating the lamp and decomposing the watery vapor driven therefrom, its oxygen being taken up by a material provided for the purpose and its hydrogen being removed by the pump.

7. The combination, with a Sprengel pump for exhausting an incandescent electric lamp, of a material situated between the pump and the lamp for taking up the vapors which arise from the pump, means for heating the lamp, and a material for decomposing the watery vapors expelled from the lamp by such heating, substantially as set forth.

This specification signed and witnessed this 15th day of July, 1886.

THOS. A. EDISON.

Witnesses:
WM. PELZER,
A. W. KIDDLE.

Correction in Letters Patent No. 438,307.

It is hereby certified that in Letters Patent No. 438,307, granted October 14, 1890, upon the application of Thomas A. Edison, of Llewellyn Park, New Jersey, for an improvement in "The Manufacture of Incandescent Electric Lamps," an error appears in the printed specification requiring the following correction: In lines 56–57, page 2, the words and figures "Patent No. 411,018, dated September 18, 1889," should read *Application No. 667 (Serial No. 208,243);* and that the Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 25th day of November, A. D. 1890.

[SEAL.]

CYRUS BUSSEY,
Assistant Secretary of the Interior.

Countersigned:

C. E. MITCHELL,
Commissioner of Patents.