G. M. J. MacKAY.

INCANDESCENT LAMP.

APPLICATION FILED SEPT. 8, 1913.

1,249,978. Patented Dec. 11, 1917.

Fig. 1.

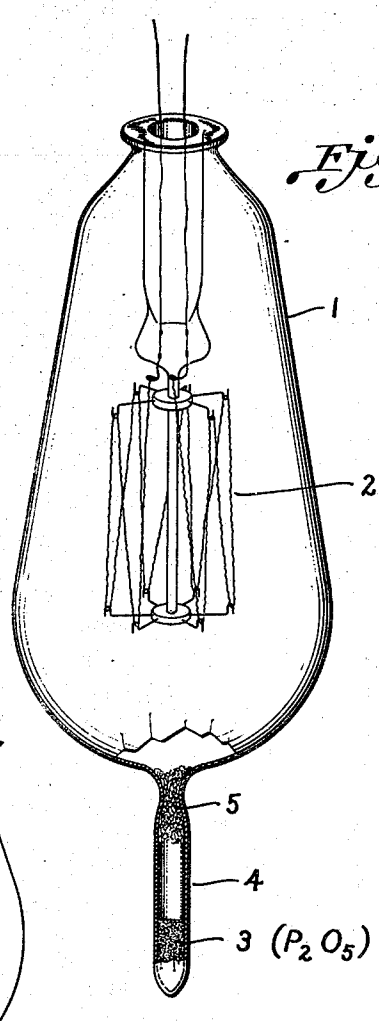
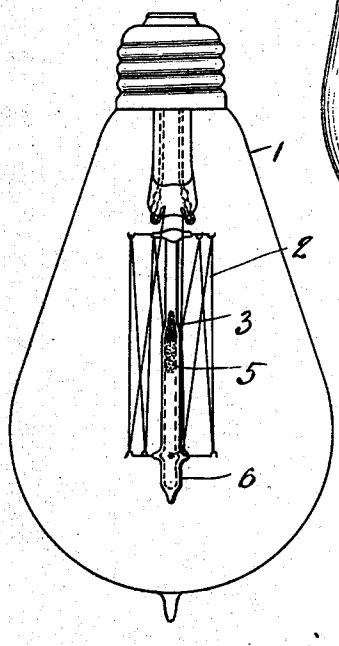


Fig. 2.



Witnesses

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UNITED STATES PATENT OFFICE.

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INCANDESCENT LAMP.

1,249,978. Specification of Letters Patent. Patented Dec. 11, 1917.

Application filed September 8, 1913. Serial No. 788,766.

To all whom it may concern:

Be it known that I, GEORGE M. J. MacKAY, a subject of the King of Great Britain, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Incandescent Lamps, of which the following is a specification.

My invention relates to incandescent electric lamps and more particularly to lamps which have filaments of refractory metal such as tungsten.

The object of my invention is to prevent blackening of the bulb, and in general to prolong the useful life of the lamp. To attain this result I place permanently in the lamp a hygroscopic substance which slowly volatilizes while in the lamp and has such a vapor tension that it maintains an atmosphere of its own vapor at suitable pressure throughout the useful life of the lamp. For this purpose I use phosphorus pentoxid, which has the chemical formula, P_2O_5. When in direct communication with the exhausted lamp bulb phosphorus pentoxid volatilizes to a slight extent and produces an atmosphere having the chemical composition P_2O_5 and a pressure so low that the filament operates substantially the same as in a vacuum, but with the marked difference that any deposit from the filament on the bulb is colorless and does not interfere with transmission of light through the bulb.

For a better understanding of my invention reference may be had to the accompanying drawing, in which merely for purposes of illustration I have shown two of the many different forms in which my invention may be embodied and in which the figures show a common form of metal filament lamp supplied with an atmosphere of phosphorus pentoxid in accordance with my invention.

Figure 1 is a perspective view of an incandescent lamp embodying my invention, and Fig. 2 is a side elevation illustrating a modification.

The particular form of lamp shown in Fig. 1 comprises a bulb 1 and a metal filament 2 of a refractory metal such as tungsten. A mass 3 of phosphorus pentoxid is so placed that it can evaporate into the bulb 1 and thereby maintain a suitable atmosphere in the bulb. This substance may be placed in any position, either in the lamp bulb or in some receptacle which communicates with the lamp bulb. There must be a sufficient quantity of the substance in the finished lamp to maintain a suitable atmosphere at the proper pressure throughout the life of the lamp. Merely for purposes of illustration I have shown the phosphorus pentoxid placed in an extension or tube 4 which at one end opens into the lamp bulb and is hermetically sealed at the other end. If desired the rate of diffusion of the vaporized phosphorus pentoxid into the bulb 1 may be controlled somewhat by varying the size of the opening or passage through which the phosphorus pentoxid vapor passes into the bulb 1. This may be done, for example, by means of a plug of glass wool or similar material 5, placed in the tube 4 between the bulb 1 and the phosphorus pentoxid.

During the entire life of the lamp the phosphorus pentoxid 3 volatilizes at such a rate that it maintains in the lamp an atmosphere of phosphorus pentoxid vapor at substantially uniform pressure. It has been shown experimentally that the presence of this atmosphere very materially improves the lamp, and while I do not wish to be restricted to any particular theory of operation, there is reason to believe that the atmosphere chemically reacts with the material driven off from the filament in such a way that the deposit on the walls of the bulb is colorless, instead of black or opaque, as would be the case if the atmosphere were not present. That some action of this kind goes on seems to be indicated by the fact that the filament loses practically as much weight as though operating in a vacuum and that the atmosphere is continually used up and must be replenished. The desired results cannot be obtained by putting in a small amount of the atmosphere and then sealing off the lamp, as in a very short time the atmosphere completely disappears and then the blackening of the bulb begins. On the other hand, if the atmosphere is continually replenished from a supply of phosphorus pentoxid in communication with the interior of the bulb, there is no blackening, and the bulb remains transparent throughout the life of the lamp. Moreover, the phosphorus pentoxid appears to absorb water vapor that may be given off in the lamp and thus prevents the otherwise harmful effect of the same in the lamp.

The pressure of the atmosphere of phosphorus pentoxid vapor in the lamp is dependent to some extent upon the temperature to which the solid phosphorus pentoxid is subjected while the lamp is in operation. In the case of tungsten filaments, for example, the pressure of the atmosphere is extremely low, substantially that existing in a well evacuated incandescent lamp.

In exhausting a lamp like that shown in the drawing, in which crystalline or amorphous phosphorus pentoxid is used, the lamp bulb is preferably heated in an oven in the usual manner to drive out occluded gases and water vapor. During this operation the phosphorus pentoxid is kept outside of the oven in a suitable tube or receptacle which is connected to the tube 4 or is in any suitable way in communication with the bulb. After the bulb is thoroughly heated and has been exhausted through the tube 4 it is sealed off from the pump. The phosphorus pentoxid is then transferred into the tube 4 by suitable manipulation, and then the tube or receptacle in which the phosphorus pentoxid was kept outside of the oven during the exhaustion of the lamp is sealed off, leaving the completed lamp as shown in the drawing. It is sometimes advisable to heat the phosphorus pentoxid slightly during the process of exhaustion to drive out of it any foreign gases or vapor that may be in it.

The marked effect of phosphorus pentoxid upon water vapor is shown by the fact that the lamp can be exhausted in much less time by the method of exhaustion just described than by the method commonly used in which phosphorus pentoxid is connected with the exhaust system but is never put directly into the lamp.

By heating crystalline or amorphous phosphorus pentoxid under suitable conditions there can be obtained fused phosphorus pentoxid, which has a much lower vapor tension than either the amorphous or crystalline form, and therefore can be heated much higher without producing too great a pressure of phosphorus pentoxid vapor. In some cases I prefer to use the fused form of phosphorus pentoxid, as it can be placed closer to the filament than the other forms without volatilizing too much and producing too great a pressure of phosphorus pentoxid vapor in the bulb. The fused phosphorus pentoxid need not be placed in a tube, such as the tube 4, but may be placed in the lamp bulb in some suitable way, as by applying it to some suitable part of the bulb, to the filament support, or by placing it in a hollow stem 6 in the manner indicated in Fig. 2.

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

1. An electric lamp comprising a sealed bulb, a body of tungsten in said bulb which is rendered incandescent when the lamp is in operation, and means for maintaining in said bulb throughout the life of the lamp a sufficient amount of phosphorus pentoxid vapor to combine with the tungsten driven off from the tungsten body to form a colorless compound therewith and thereby prevent the blackening of the bulb.

2. An electric lamp comprising a sealed envelop, a body of tungsten in said bulb rendered incandescent when the lamp is in operation and a mass of fused phosphorus pentoxid positioned in said bulb to produce by volatilization at the temperature attained by it during operation of the lamp an atmosphere of its vapor at a pressure not exceeding that of a first class vacuum.

3. An electric lamp comprising a sealed bulb, a light giving body of tungsten in said bulb rendered incandescent when the lamp is in operation, a mass of phosphorus pentoxid inside the bulb in position to be volatilized by the heat from said body of tungsten to maintain an atmosphere of its vapor at a pressure not exceeding that of a first class vacuum when the lamp is in operation.

4. An electric lamp comprising a sealed bulb, a tungsten filament in said bulb and means for maintaining in said bulb throughout the life of the lamp when the lamp is in operation an atmosphere of phosphorus pentoxid vapor at a pressure not exceeding that of a first class vacuum.

In witness whereof I have hereunto set my hand this 6th day of September, 1913.

GEORGE M. J. MacKAY.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.