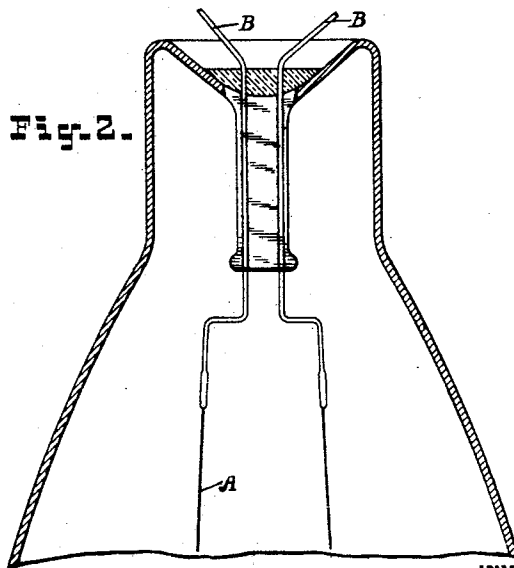
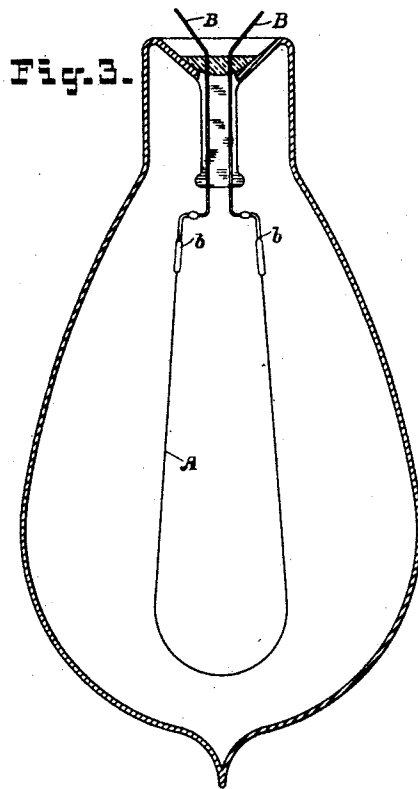
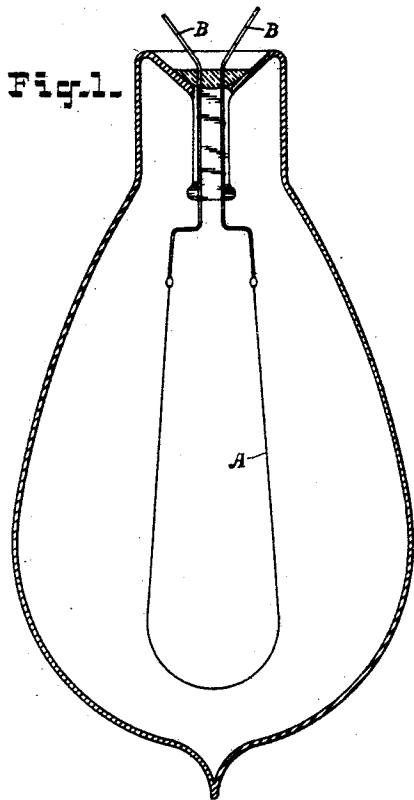


F. S. SMITH.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

No. 471,576.

Patented Mar. 29, 1892.



WITNESSES:

James H. Smith
Walter B. Floyd

INVENTOR,

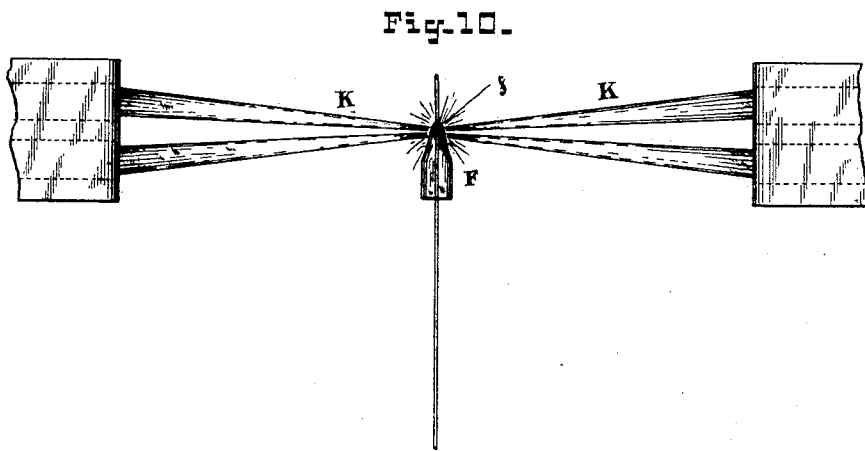
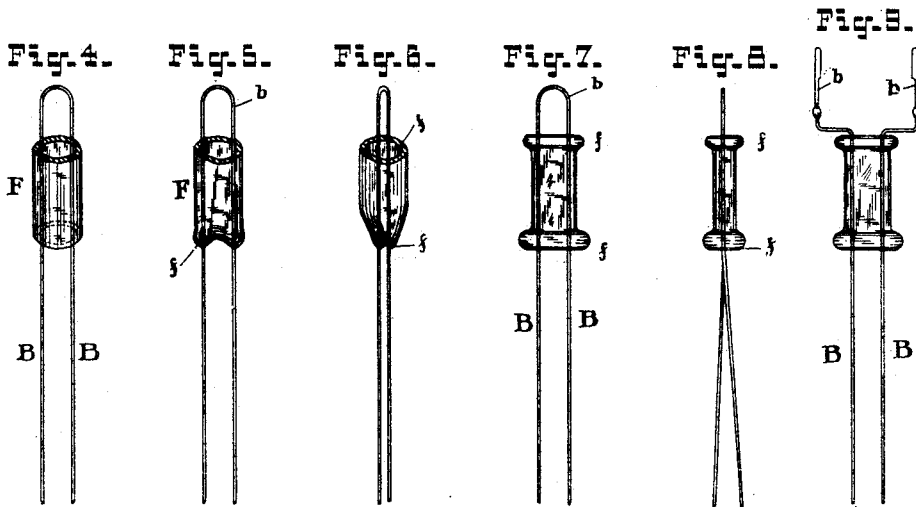
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UNITED STATES PATENT OFFICE.

FRANK S. SMITH, OF PITTSBURG, PENNSYLVANIA.

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 471,576, dated March 29, 1892.

Application filed December 22, 1890. Renewed October 5, 1891. Serial No. 407,690. (No model.)

To all whom it may concern:

Be it known that I, FRANK S. SMITH, a citizen of the United States, residing in Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Incandescent Electric Lamps, of which the following is a specification.

The invention relates to certain improvements in incandescent electric lamps.

In the construction of incandescent electric lamps the carbon conductor is supported upon small metallic wires which pass through the walls of the inclosing chamber and serve to convey the current to the conductor. It is essential to the preservation of the carbon conductor that a very high vacuum be maintained in the globe, and hence in lamps as heretofore constructed it has been necessary that the union of the glass and the metallic conductor at the point of entrance should be so perfect as to prevent any leakage. The leading-in wires, as well as the glass, become heated by the current flowing through them and by the radiation from the carbon conductor. There is a consequent expansion of both the glass and the metal when the lamp is in use and a contraction of the same when the current is turned off. It is evident, therefore, that, owing to very intimate union of the glass and the metal required to form a perfectly air-tight joint, it is necessary that the coefficient of expansion of the metal should be very nearly the same as that of glass. Platinum is a metal possessing in a remarkable degree the property of forming an intimate union with glass, and its coefficient of expansion is very nearly the same as that of glass. These characteristics conspire to render it a most appropriate material for forming the leading-in conductors and have caused its universal adoption for that purpose. There exists, however, one serious objection to its use, which has led to numerous hitherto unsuccessful endeavors to use other materials. This objection lies in the great expense of the metal itself. The amount of platinum wire ordinarily used in a sixteen-candle-power lamp is from one and a half to two and a half inches, and it represents about one-fifth of the entire cost of the lamp. (In a fifty-candle-power lamp the item of plati-

num alone usually amounts to about twenty cents.) It is estimated that there are now in use in the United States alone not less than two million five hundred thousand incandescent electric lamps using platinum leading-in conductors. From this it will be apparent that the utility of any economy in its structure cannot be overestimated.

In constructing an incandescent lamp it is customary to mount the carbon conductor upon the platinum wires and to fuse the glass upon or about them. The bulb is then exhausted and sealed. In this manner a continuous glass globe or chamber is formed about the conductor. By my invention the use of platinum is practically dispensed with and the leading-in wires are formed of iron. The cost of this material is so insignificant that it may be practically neglected in estimating the actual cost of the lamp.

In carrying out my invention I usually construct the lamp in the following general manner: An iron wire of the proper size is first carefully cleaned and brightened by polishing with emery-paper or in any other convenient manner. Two wires or the arms of a single piece of wire bent upon itself are then held in their proper relative positions for forming the stem. A small quantity of glass is then fused upon the wires, fixing them in position. A sufficiently-close joint cannot be produced by fitting the wires into openings previously formed in the glass, and it is necessary that the glass be formed about or molded upon the wires by fusing or melting it. This can be done in a glass-blower's flame; but as iron oxidizes very quickly when highly heated in this flame care must be exercised to guard against excessive heat and also against exposing the iron to the direct action of the flame. In forming stems with platinum this care is not required, for platinum does not oxidize even when subjected to an intense heat in such a flame, and it may be added that it is probable that the fact that its surface remains thus free from oxidation in a measure accounts for the perfection of its union with the glass under heat.

In practice I usually first pass the wires through a tube or tubes of glass and then fuse one end of the tube upon the wires. The envelope thus formed protects the wires from

currents of air and from the direct action of the blow-pipe flame. The tube is then gradually fused along its length from the end so closed.

5 Other methods of applying the glass to the iron wires without excessive oxidation may be employed. Even with these precautions in the process of coating the iron wires with glass a thin film or scale of oxide will usually
10 form upon the wires and intervene between them and the glass. This film or scale prevents the formation of the completely air-tight joint, which is secured by the use of platinum leading-in wires; but I have found
15 that by afterward applying a suitable cement or plastic substance at the point where the wires enter the glass a perfectly air-tight seal is obtained.

In practice I have obtained excellent results by the use of a sealing compound consisting of a mixture of the yellow oxide of lead, one part; the red oxide of lead, two parts; and the carbonate of lead, about five parts, all thoroughly mixed and ground with boiled
25 linseed-oil sufficient to form a thick paste. Other vehicles than linseed-oil may be used and the proportions may be varied somewhat. Asphaltum varnish also gives good results, and other suitable cements may be used. The
30 cement may be applied before or during the process of exhausting the bulb. When the exhaustion has been effected, the lamp is sealed and removed from the pump in the usual manner.

35 I have found that lamps constructed with iron leading-in wires in the general manner described above and having the points where the wires pass through the glass thus protected by a cement or suitable sealing compound
40 are in every way as durable and efficient as those employing platinum leading-in wires, and at the same time the great saving in the expense is a matter of the utmost importance.

In the accompanying drawings, illustrating
45 the invention, Figure 1 is an elevation of a complete lamp. Fig. 2 is an enlarged view of the leading-in wires and a portion of the bulb, and Fig. 3 illustrates a modification. Figs. 4, 5, 6, 7, 8, 9, and 10 illustrate a method of applying glass to the iron wires in forming the
50 stem.

Referring to the figures, A represents a carbonized conductor prepared in any suitable and well-understood manner. This conductor
55 is supported at the ends of two leading-in wires B B of iron.

The principal steps in the process of preparing the stem are illustrated in Figs. 4 to 10, inclusive. A bright clean piece of iron
60 wire is bent into the shape indicated in Fig. 4. A short tube F of glass is then slipped over it, and the flame K (indicated in Fig. 10) is directed perpendicularly against opposite sides of the tube F near one end *f*. This
65 softens or fuses the glass at that point, flattening it against the wires and completely embedding them. The end *f* of the tube is

thus closed and circulation of air, which would tend to oxidize the iron, is prevented. The parts are then in the form shown in Figs. 5 and
70 6. The flame is then directed toward other parts of the tube, causing it to melt and close about the wires, the fusion being preferably continued from the end *f* toward the end *f'* until the entire tube is formed into a solid mass,
75 as shown in Figs. 7 and 8. Throughout this process care is taken to prevent, as far as possible, the flame from coming against those portions of the iron which are to be embedded in the glass. This prevents the formation of
80 an excessive coating of oxide upon the surface of the wire. A thin scale of film will, however, usually be formed, even if great care be exercised; but its presence is found not to be detrimental to good results, and it is
85 possible that its presence may serve a useful purpose in the completed lamp in preventing the glass from being cracked by the unequal expansion of the glass and the iron, the coefficient of expansion of the latter being greater
90 than that of glass.

In practice it is convenient to employ a single piece of wire having the loop *b'* for forming the two wires B B, and after the glass is fused upon the two arms the loop is cut open
95 and the ends bent into the proper positions to receive the ends of the carbon conductor or the tips *b b*, as the case may be. If the iron wires themselves are to receive the ends of the conductor, then suitable sockets or
100 terminals may be formed on them. Certain of the methods of mounting carbon conductors require the use of heat greater than that which iron can endure without injury. When such processes are used, the iron wires may
105 be tipped with platinum or other suitable metal having a higher fusing-point. Such tips are shown at *b b*, Figs. 3 and 8, and they are attached by soldering or in any other suitable manner. After the carbon conductor
110 has been attached and the stem, with its leading-in wires, inserted in the lamp-bulb and the neck of the bulb has been closed upon the stem a suitable cement or sealing compound is applied about the wires, as indicated
115 at K, and the lamp is then exhausted in the usual manner, the cement being forced between the wire and glass by the atmospheric pressure.

With the use of platinum leading-in wires
120 it is customary to economize the platinum outside the lamp-bulb by soldering thereto extensions of copper wire for securing connections with the lamp-bottom contacts. This extra step in the manufacture is not necessary when iron wires are used; but the iron
125 wires are themselves made of sufficient length to permit the attachments.

To prevent the iron wires from being injured by long exposure to the atmosphere or by
130 the moisture from the cement used to fasten the lamp-bulb into the bottom, they may be varnished or coated with suitable protecting material.

I claim as my invention—

1. An incandescent electric lamp consisting of a carbonized conductor, an inclosing-bulb of glass, leading-in conductors of iron wire, glass fused upon the wires and to which the bulb is fused, and a cement or sealing substance surrounding the iron wires at the point of entrance into the glass.
2. An incandescent electric lamp consisting of a carbonized conductor, an inclosing bulb of glass, leading-in conductors of iron upon which the glass of the inclosing chamber is fused, and a cement or sealing substance surrounding the iron wires at the point of entrance into the chamber.
3. In an incandescent electric lamp, iron wires coated with glass by fusion, passing through the walls of the globe and supporting the carbonized conductor, and a cement or equivalent substance closing any space between the glass and iron wires.
4. In an incandescent electric lamp, iron leading-in conductors passing through the walls of the bulb, films or scales of oxide of iron intervening between the iron and glass, and a cement surrounding the wires at the point of entrance into the bulb.
5. The method of forming stems upon iron leading-in wires for incandescent electric lamps, which consists in passing the iron wires through tubes of glass, fusing one end of a tube upon the iron wire, and then gradually fusing the rest of the tube thereon, substantially as described.

In testimony whereof I have hereunto subscribed my name this 28th day of November, A. D. 1890.

F. S. SMITH.

Witnesses:

PAUL WINSOR,
J. W. SMITH.