(No Model.)

F. M. F. CAZIN.

INCANDESCENT ELECTRIC LAMP.

No. 523,460. Patented July 24, 1894.

Fig. 1.

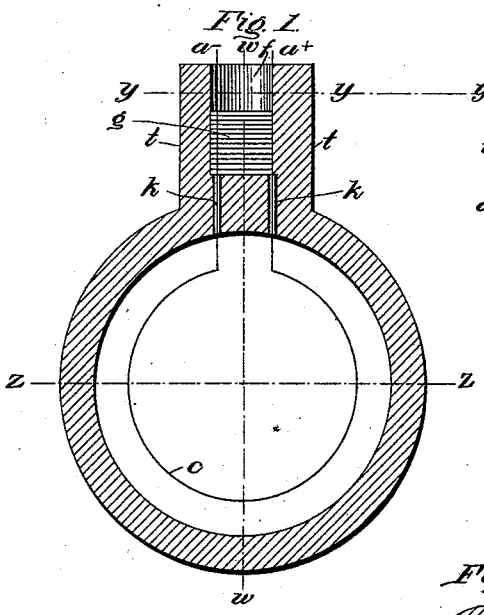


Fig. 2'.

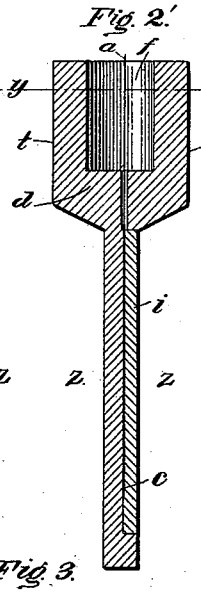


Fig. 2".

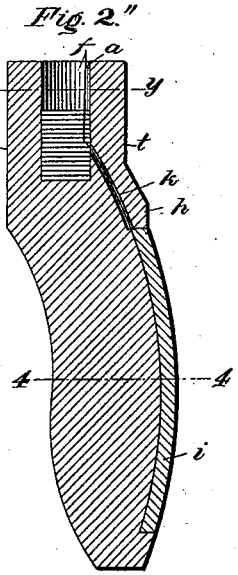


Fig. 3.

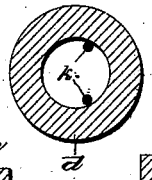


Fig. 4'.

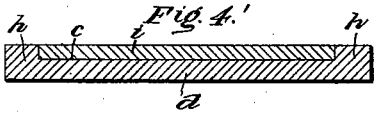


Fig. 4".

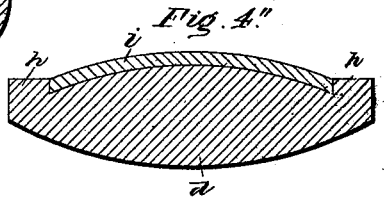


Fig. 5.

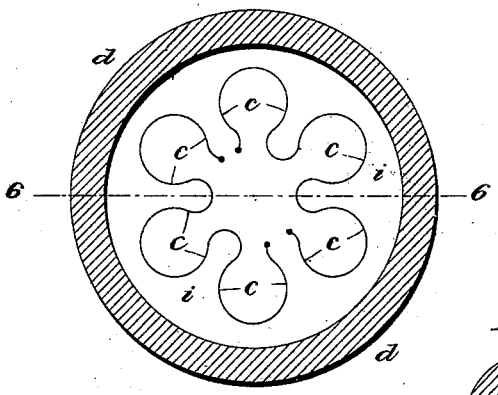


Fig. 6.

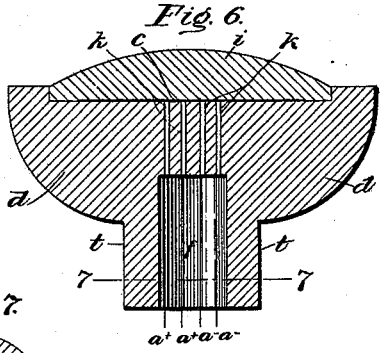
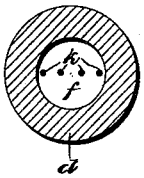


Fig. 7.



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UNITED STATES PATENT OFFICE.

FRANCIS M. F. CAZIN, OF HOBOKEN, NEW JERSEY.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 523,460, dated July 24, 1894.

Application filed December 7, 1892. Serial No. 454,412. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. F. CAZIN, a citizen of the United States, residing at Hoboken, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Incandescent Electric Lamps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Incandescent electric lamps, as they are now in use, consist of four parts, or have four characteristic elements essential to their construction and to their effectiveness, namely: first, the filament that is to be heated by an electric current to incandescence; second, a hollow receptacle or bulb, of glass, in which the said filament is inclosed; third, a space surrounding the said filament, within the said glass receptacle, from which space the air has been exhausted for the purpose of preventing the combustion of the incandescent filament, which would take place if air were present; fourth, a solid neck, prolongation or stopper to the glass receptacle, serving the different purposes of holding the incandescent filament in place within the glass receptacle, and of sealing the receptacle against access of air from outside, and of making a possible secondary connection through the medium of platinum wires between the incandescent filament inside and the electric conductors outside. The filament used is of sufficient solidity to hold its shape in the receptacle, being supported only at its ends or at the points where its connection with the electric conductors is made. But this filament is of necessity of a minute transverse section and, in consequence, is subject to vibration, which interferes with the production or distribution of a steady light, and under the influence of jar or shock it easily breaks, whereby the lamp becomes inefficient. On account of the filament being fragile, the shape into which it can be bent or looped is narrowly limited to a few simple linear forms.

As the glass receptacle or bulb leaves space between the incandescent matter and its walls, and as this space must be exhausted of the air otherwise filling the same, there is an atmospheric pressure on the outside of the glass, in consequence of which it easily breaks, and when only slightly touched or pressed or knocked against, the life of lamps being thus shortened by their breaking under slight concussion or touch.

As an absolutely perfect vacuum cannot be obtained in the space left surrounding the incandescent matter, and as even such vacuum as can be obtained cannot be maintained for a great length of time on account of leakage, under such pressure and on account of the glowing matter itself giving off gases; the incandescent matter, although protected against immediate combustion, is destroyed within a limited length of time, and the inner surface of the glass receptacle becomes covered with the product of a slow combustion.

I have devised an electric lamp, designed for operation on the principle of incandescence, in which the semi-conductive material intended and adapted for being electrically heated to incandescence, is not necessarily a filament surrounded by an empty space, but is such matter of any degree of cohesiveness or non-cohesiveness, such as powder, &c., in the shape of a solid line of a minute transverse section, embedded entirely and directly in a solid, non-conducting, mainly transparent material, such material being either entirely glass or faced with glass, so as to permit the radiation of light; and the carbonaceous or other semi-conductive material so embedded, in the form of a solid line, is connected at the ends to leading-in wires of metal, preferably of platinum, the incandescent material, together with the connection as stated, being hermetically sealed against the access of any air to the incandescent matter.

It is manifest that in a lamp so constructed, many of the difficulties and disadvantageous conditions and their consequences connected with the incandescent lamps at present used, are overcome, and that several causes of shortening the life of the incandescent lamps at present used, are avoided, and that new advantages in construction, durability and economy are thereby secured.

The necessity of creating a vacuum is entirely done away with, and the maintenance of such a vacuum is no longer a condition of the life of the lamp. It is no longer neces-

sary to employ a fragile, unsupported, vibrating filament, standing free in a vacant space, that by its fragility is limited in form to a few bends or loops. By a process of construction, to be described hereinafter, the incandescent matter is formed and held, by my improved lamp, in a linear space, prepared in advance, in solid matter, and is protected against combustion by being completely surrounded by such solid matter, that is non-conducting, mainly transparent, and has no chemical affinity for the semi-conductive, incandescent matter that would result in changing the nature and form of the incandescent matter. Nor is there in my lamp any extra outside pressure on a glass protecting a vacuum, which pressure in the older lamps causes the lamp to break under slight percussion.

As incidental to the preparation of a lamp such as I have described, I have devised the process hereinabove referred to of carrying out my invention, the object being to secure the embedding of the carbonaceous or other semi-conductive matter in the glass, without destroying it by the heat of the glass were it applied in a plastic state, and without interfering with the shape or bendings of the said matter.

The process consists essentially in making first by the usual methods—that is by the use of a mold—a piece of glass or of other non-conducting matter, having an intaglio impression of such linear shape, as it is desired to give to the incandescent matter, it being understood, that the two ends of the linear mass are connected by groove or channel with the metallic leading-in wires. And this process of making my improved incandescent lamp is completed by causing another piece or plate of glass, so shaped as to precisely fit the other piece already mentioned, on the face that has the said intaglio impression, and the semi-conductive matter intended to glow, pressed thereinto, to adhere to the said last named piece, either by using a cementing medium, or by joining the two pieces when either or both are in a state of semi-fusion or fusion, sufficient to cause their joining without the loss of their shape, or by dipping the two when closely joined, into fused glass, causing the whole to be and remain covered with a glass coat. To accomplish this result, the two pieces are each made of suitably selected material with regard to their point of fusion, that in which the matter intended to glow is embedded having preferably the higher degree of fusion of the two. With this process of construction, the matter intended and adapted to become incandescent will not be subjected to the danger of being destroyed or disturbed in its shape, it being held and embedded within the intaglio indenture.

I may substitute for the glass having the intaglio indentation, as above described, some reflecting substance, or some substance like porcelain, which is not easily affected by heat, the sole condition being that one of the substances coming in contact with the matter that is intended to glow shall be of glass, or, in other words, that at least one of the two component parts of the lamp body shall be transparent. The above is the essential condition, so far as the radiation of light is concerned. Another condition is that the two solid lamp elements (referring now to the lamp body) shall be capable of being joined airtight. It is also contemplated that under such tendency to fuse as will be naturally brought about in the working of the lamp, one of the elements of the lamp body shall remain rigid, even though the other may become plastic. This, I say, is a contemplated, but not an essential feature of the lamp. It only remains to add here that kind of glass, or the composition and preparation of the kinds of glass, employed in the lamp must be carefully selected with respect to point of fusion, brittleness, and to the question or change of transparency by reason of heat.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a section of an incandescent electric lamp, constructed in accordance with my invention, the shape chosen in this instance for the glowing matter, and the non-conducting matter in which it is embedded, being circular; and the face of the lamp being a plane. Fig. 2′ represents a section through line *w*—*w* in Fig. 1. Fig. 2″ is a similar section of a lamp, having a convex instead of a plane face. Fig. 3 is a section along line *y*—*y*, in Figs. 1, 2′ and 2″. Fig. 4′ is a transverse section of the lamp, as shown in Figs. 1 and 2′, along the line *z*—*z*. Fig. 4″ is a transverse section of the lamp shown in Fig. 2″ along the line 4—4. Fig. 5 is a plan of a lamp having two films or masses of semi-conductive or carbonaceous matter, the said films or masses being shown at the face of the lamp in ornamental shapes, for producing special effects. Fig. 6 is a section along the line 6—6, in Fig. 5, and Fig. 7 is a section along the line 7—7, in Fig. 6.

Referring to the drawings by letter, *d*, is the base-plate of my lamp, the same being made like the front-plate *i*, of non-conducting material. At least one of the two plates, *d* and *i*, must be transparent. The base-plate, *d*, has upon one face a slight intaglio indentation, which appears at *c*, *c*, upon the drawings. This indentation is linear, forming in the instance illustrated in Figs. 1, 2′ and 2″, a circular line with an interruption where the two ends traverse tubular perforations marked *k*, *k*, into a recess, *f*, in the lamp socket, *t*. When the lamp is made ready for use, this intaglio indentation is filled with semi-conductive or carbonaceous matter, the transverse section of the space which it occupies being so small that the whole mass or film will offer such resistance to the electric current as to cause the said mass or film to become incandescent, and so produce light.

By preference, the leading-in wires, *a*, *a*, will pass through the recess, *f*, and the tubular perforations, *k*, *k*, and the junction may be made within the said perforations, *k*, or recess, *f*, as may be found most desirable. I have therefore shown the perforations *k*, *k*, and part of the recess *f*, filled with the carbonaceous or other semi-conductive matter and the metal (platinum) wire penetrating through the recess *f*, and extending close to the indentation as described, whereby a considerable area of contact is provided between the wire and the matter intended to be electrically heated to incandescence, and whereby the junction between this matter and the conducting wires may be made permanent and adequate. And the main part of the recess *f*, serves to be filled with such non-conducting material, *g*, as will effectively seal the semi-conductive matter and its joint with the wires against the access of any air from outside thereto.

It will be seen that the base-plate, *d*, in the lamps, as represented in the drawings, has projections, *h*, *h*, or, rather, a single such projection, circular in form, the object being to receive within the rim formed by the projection the front-plate, *i*. This is a non-essential feature, but structurally it may be useful to have such a rim, or more than one, either upon the base-plate or the front-plate, the corresponding plate in each case being shaped to fit. The principal point is that a close, hermetical fit between the two plates be brought about, and thereby the access of air or gas be avoided.

The two plates may be either cemented together, or one plate may be fused to the other, or both plates may be fused together after the carbonaceous or other semi-conductive matter has been put in place and has been covered by the other transparent plate fitting to and covering the same. I prefer to arrange the two plates in such a manner that the heat shall produce whatever perceptible effect it will have, on only one of the two parts or plates, the affected plate being so adapted thereto that the efficiency of the lamp will not suffer thereby. Although this is not an essential point, it is contributive to the prolongation of the life of the lamp and to the re-utilization of parts when it needs repair. In any and all cases, I so select the kind of glass and other material to be used in the construction of my lamp, that the effect of heat thereon will not incapacitate the part made thereof for its purpose, or, in other words, I so select the composition of these parts that they will neither crack, nor lose their transparency, nor fuse to the extent of losing their shape under the action of the heat that produces incandescence.

In Figs. 2″ and 4″ I show a base-plate with a face of convex form and a front-plate shaped exactly to fit the same, while in Figs. 1, 2′, 4′, 5 and 6, the base-plate has a plane face, the front-plate also fitting exactly thereto, but being in Figs. 1, 2′, and 4′, a plate of equal thickness at all points, and in Figs. 5 and 6 a lens, of spherical segment. But the question of shape in either plate is immaterial except as to the conditions heretofore stated, the shape of the face with the indentations and of the co-operating cover or front-plate being material only with regard to the direction of radiation, but not as to the protection of the carbonaceous or other semi-conductive matter against deterioration by the heat, as long as the one plate absolutely fits to the other and fully and hermetically covers and incloses the incandescent matter.

In the socket, *t*, which forms in the illustrations shown by me a prolongation of the base-plate or main part of the lamp, there is at its outer end a recess, *f*, partly filled with non-conducting material, *g*, through which the conducting wires, *a*, *a*, pass, and by which the openings or passages, *k*, *k*, are hermetically sealed.

In Fig. 5, two linear indentures, the one independent of the other, are shown on the face of the base-plate, and an independent channel joining the two ends of either for connecting the semi-conductive matter pressed into each of the indentations by wire, as heretofore described, through the four channels, *k*, *k*, *k*, *k*. And the indentations form an artistic design so as to illustrate the less limited selection of design for the incandescent matter, which results from my improved construction of incandescent lamp when compared with such lamps at at present constructed. The other differences in shape are also in this instance immaterial to the extent heretofore specified, but they are intended to illustrate the fact that under my improved construction of the electric incandescent lamp, there is a greater facility for adapting the shape or form of the lamps to specific purposes and artistical designs, as well as to desired optic effects of radiation, and that the lamps as improved by me may be constructed light, as well as of great solidity and endurance, all its conditions and qualities tending to give it a comparatively much longer life than the vacuum lamp can be expected ever to attain.

In using the term "semi-conductive matter," I wish to include carbonaceous or other suitable material, such as conductive matter in a semi-conductive state. For example, powdered metal might answer my purpose, the metal in that state being what I call semi-conductive, and being capable of use for the purposes of my lamp.

Having now described my invention, what I claim and desire to secure by Letters Patent, is—

1. An electric incandescent lamp, in which the semi-conductive matter intended and adapted to glow is closely, directly and hermetically embedded in non-conducting solid matter made up of two parts, one part having a high point of fusion, whereby the shape of the intaglio impression containing the semi-

conductive matter is maintained, and the other part being mainly transparent, whereby the necessary conditions of luminosity and transparency are fulfilled, substantially as described.

2. An electric incandescent lamp in which the semi-conductive matter intended and adapted to glow is closely, directly and hermetically embedded in non-conducting solid matter made up of two parts of different points of fusion, substantially as described.

3. An electric incandescent lamp in which the semi-conductive matter intended and adapted to glow is closely, directly and hermetically embedded in non-conductive solid matter made of two parts, one part being opaque and the other mainly transparent, substantially as described.

4. An electric incandescent lamp, in which semi-conductive matter adapted to be brought to incandescence by the electric current is closely, directly and hermetically connected in solid non-conducting matter, the said lamp being made up of two parts, one of which has on its face an intaglio impression of linear form, filled with incandescing matter, and the other of which closely fits the first mentioned part, leaving between the two parts only such space as is occupied by the incandescing matter, as and for the purpose set forth.

5. An electric incandescent lamp, in which semi-conductive matter adapted to glow under the electric current is closely, directly, and hermetically embedded in non-conducting solid matter, the said lamp being made up of two parts, one of which is the base, which holds the leading-in wires, and has means for connecting them with the terminals of the incandescing matter, and the other of which has such incandescing matter embedded in it, the two parts being hermetically joined together.

In testimony whereof I have signed my name, in the presence of two witnesses, this 6th day of December, A. D. 1892.

FRANCIS M. F. CAZIN.

Witnesses:
H. A. ACKEN,
G. H. STOCKBRIDGE.