(No Model.) 3 Sheets—Sheet 1.

H. COTTRELL.

ELECTRICAL GLOW LAMP.

No. 515,465. Patented Feb. 27, 1894.

Fig. 1.

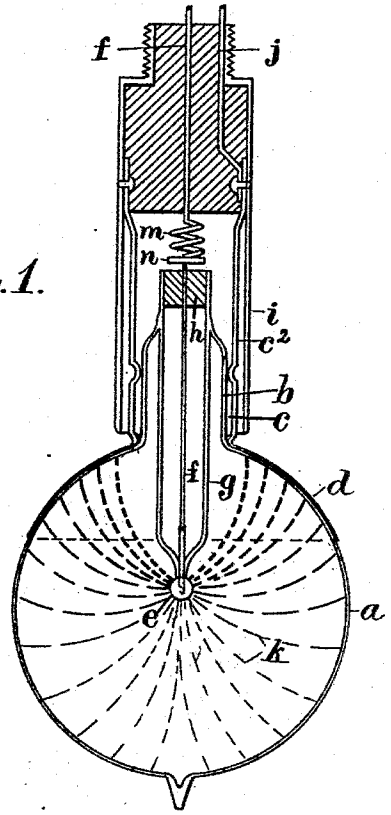
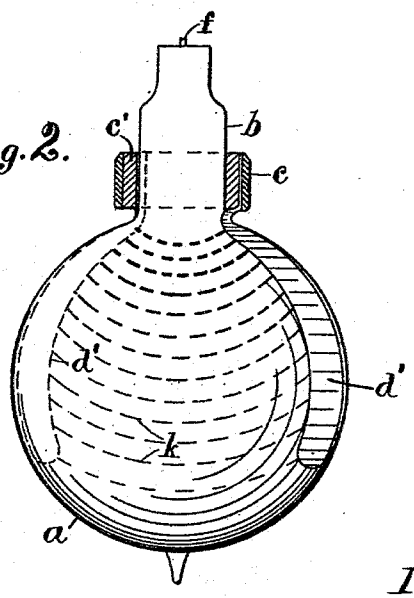


Fig. 2.



Attest:
L. Lee.
Edw. F. Kinsey.

Inventor.
Herbert Cottrell, per
Crane & Miller, attys.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

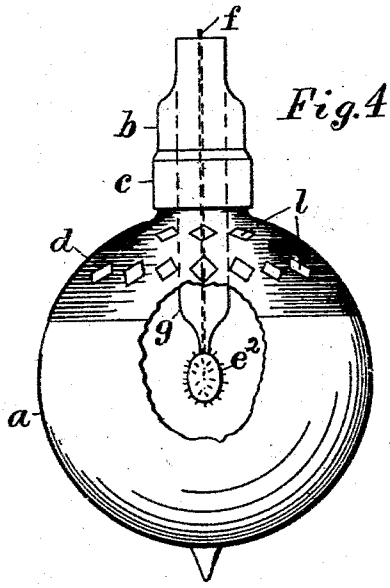


Fig. 3.

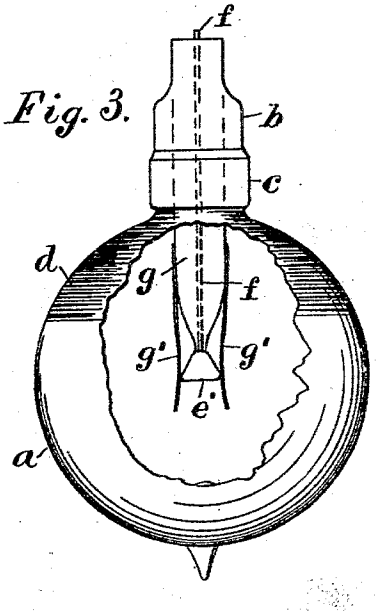


Fig. 5.

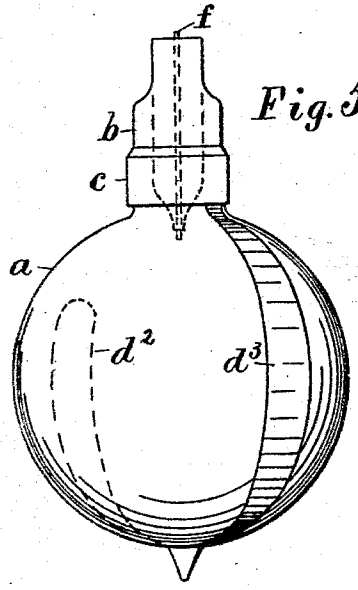
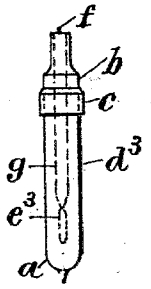


Fig. 6.

Fig. 7.



Attest:
L. Lee.
Edw. F. Kisey

Inventor.
Herbert Cottrell, per
Crane & Miller, attys.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 3.

H. COTTRELL.

ELECTRICAL GLOW LAMP.

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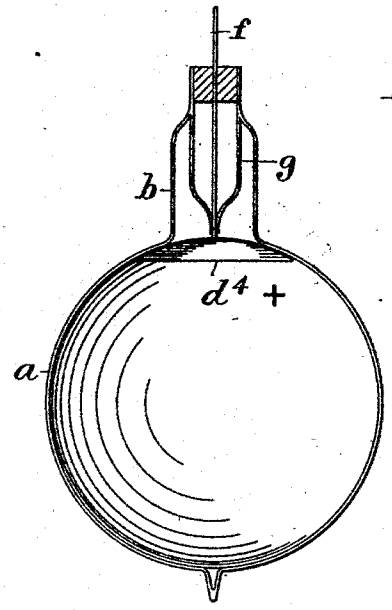
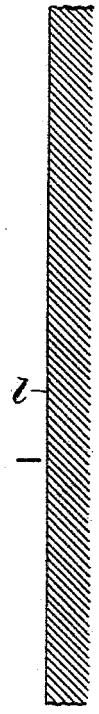


Fig. 8.



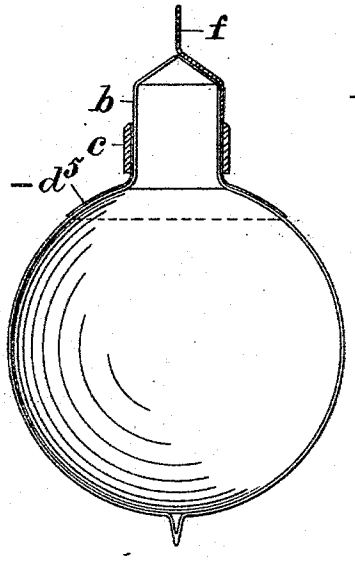
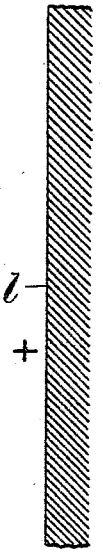


Fig. 9.



Attest:
L. Lee.
Edw. F. Kinsey.

Inventor
Herbert Cottrell, per
Crane & Miller, attys.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HERBERT COTTRELL, OF NEWARK, NEW JERSEY.

ELECTRICAL GLOW-LAMP.

SPECIFICATION forming part of Letters Patent No. 515,465, dated February 27, 1894.

Application filed March 30, 1893. Serial No. 468,309. (No model.)

To all whom it may concern:

Be it known that I, HERBERT COTTRELL, a citizen of the United States, residing at Newark, Essex county, New Jersey, have invented certain new and useful Improvements in Electrical Glow-Lamps, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of this invention is to produce a lamp illuminated by an electro-magnetic discharge. The illumination is effected by applying a coating of conductive substance, as for instance tin foil, to the surface of an exhausted glass bulb, and connecting such coating with an electric conductor in a circuit adapted to induce an electro-magnetic discharge across the interior of the bulb. By coating the exterior or interior of the bulb with a conductive substance, I furnish a surface analogous to that used in an electric condenser, from which the electro-magnetic emanations may flow. In some forms of the invention I furnish the bulb with two conductive bodies connected by wires with the positive and negative poles of an open electric alternate circuit, (as for instance a battery and induction coil) from the terminals of which the electro-magnetic discharge passes through the bulb. In other cases I furnish the bulb with only a single conductive body or coating applied to one side of the same and connected with a single pole, and secure a discharge from such coating through the bulb, by affording a free discharge path to the earth, or its equivalent. In such construction the surface of the glass, opposite to that upon which the single conductive coating is applied, forms a true condenser surface, and operates effectively in producing the electro-magnetic discharge. One of the conductive bodies may consist of an electrode of spherical or conical form sustained in the center of the glass bulb within a vacuum, and the other body may consist of a metallic coating applied to one side of the bulb externally. The body within the bulb is for convenience termed the electrode herein, and is preferably connected with the positive conductor coming from the source of electrical energy; and the body upon the exterior of the bulb is termed the coating, and is preferably connected with the negative conductor; as I find that the light generated by the lamp is more intense with such connections. By applying a conductive coating to one side of the glass bulb upon its exterior the remainder of the bulb is exposed to permit the diffusion of light when generated. When connected with a suitable generator an intense electro-magnetic discharge is produced between the coating and the central body, and such portions of the bulb as do not lie between these points are also caused to glow with light of considerable intensity. Such glow is caused by the electro-magnetic lines of force which extend in all directions from the coating and the central body, and which produce such glow within the exhausted portion of the bulb. By forming the exterior coating of a reflecting substance like that upon a glass mirror, the light generated in the bulb is powerfully reflected from its opposite side.

In my invention no arc or closed circuit is formed between the ends of the wire conductors, as is common in the use of dynamic electricity in currents of any kind for illuminating purposes, but the glow of the lamp is produced by the electro-magnetic lines which intersect the exhausted bulb.

In the drawings, Figure 1 represents in longitudinal section a lamp connected with a lamp socket and having a spherical electrode in the center of the bulb. Fig. 2 is a similar view partly in section, of a lamp with strips of conductive material upon its opposite sides and no electrode within the bulb. Figs. 3, 4, and 5 are perspective views of lamps similar to Fig. 1 with electrodes of different shapes. Figs. 6 and 7 are a front and edge view of a lamp of modified construction for medical explorations. Figs. 8 and 9 are diagrams of one wire-lamp in section.

The bulb *a* is shown provided with a tubular neck *b* having a metallic collar *c* fixed upon the same to secure the bulb in a lamp holder. The conductive coating *d* upon the exterior of the lamp is shown in contact with such collar, and the interior electrode *e* is provided with a conducting wire *f* extended outside of the lamp through the neck *b*. To prevent an electro-magnetic discharge between such wire and the collar which encircles the neck, the wire is coated with glass and may

also be surrounded by an annular body of air, which offers a much higher resistance to the magnetic discharge than the vacuum within the bulb. Such body of air is furnished by means of a glass tube g which is extended through the neck to the center of the bulb and hermetically sealed to the neck at its outer end. The inner end of the tube is hermetically sealed about the conductor f close to the electrode e which is thus held firmly in its required position. A plug of plaster or other convenient material h is applied to the outer end of the air tube g to sustain the conducting wire f, upon the end of which the contact is made in the lamp holder.

The lamp socket i is adapted to receive the collar c and to connect the same by springs c^2 with one pole of the open electric circuit; and a separate conductor j within the socket is provided with a spiral spring m and button n to make contact with the end of the wire f. The exterior and interior of the lamp may thus be connected with either pole.

The conductive coating is shown in Fig. 1 covering a zone of the bulb upon the upper third of its surface concentric with the collar c, and thus concentric with the electrode and its conductor f. When connected in the open electric circuit the discharge between the coating and the electrode fills the upper end of the bulb with light, and produces also a strong glow in the lower end of the bulb which is unprovided with a conductive coating.

Dotted lines k of varying intensity are shown extended from the electrode to the coating to illustrate the diffusion of light within the same.

It will be observed that the positive and negative conductors which are furnished by the lamp socket i are not united in any manner in the lamp to form a conducting circuit, but are carefully insulated from one another, and intentionally separated by a very considerable space, to utilize the electro-magnetic discharge.

It is obvious that the coating d may be made by silvering the exterior of the bulb like a glass mirror, and the light generated in the bulb is thus reflected most powerfully from such coated side. The light is thus concentrated upon any object at one side of the lamp without employing an extraneous reflector.

The electrode shown in the center of the lamp and thus illustrated in Figs. 3 to 5 inclusive, may be formed of graphite, carbon, or other conductive material, and I have found that the admixture of metallic powder or salts with the body of such electrode varies the color of the light produced within the bulb.

With the lamp shown in Fig. 2, two strips or bands d' of conductive coating, as for instance tin foil, are extended lengthwise of the bulb upon its opposite sides, and connected with the positive and negative poles of the generator. With such construction no internal electrode or conductor is required, but the electro-magnetic discharge passes across the exhausted bulb from one coating to the other, and illuminates the bulb in the desired manner. With this construction one of the coatings may be insulated from the interior of the collar c by a suitable packing c', and may be extended over the neck b to make contact with the central conductor j of the socket; the other strip being connected with the collar and making contact with the exterior of the socket, as in Fig. 1.

Fig. 3 represents a lamp analogous to Fig. 1, with the electrode e' of conical form with its apex attached to the conductor f. Two filaments g' are shown attached to the tube g upon its opposite sides, and their loose ends pressed elastically upon the base of the cone. Such filaments may be made of filamentous carbon, and may be attached to the glass tube g by silicate of potassa. To avoid confusing the drawings, I have shown but two of such filaments; but in practice I have applied from twelve to twenty of such filaments to the tube, and find that they greatly enhance the brilliancy of the light, as the filaments radiate light within the bulb in harmony with the electro magnetic discharges.

The conical electrode, when used without the filaments, induces brilliant rays from the base of the cone, and the whole lamp glows with greater intensity than with a spherical or oval electrode.

In Fig. 4 the electrode e^2 is shown of egg-shape with small wires or conducting points projected therefrom. With such an electrode the magnetic discharge is concentrated chiefly upon such points, and the illumination is less intense and less diffused than with a smooth electrode.

In Fig. 5 the bulb is shown with a conductive strip d^2 extended from the collar around one side and end of the bulb and partly around the opposite side; while the conducting wire f is projected but very slightly through the neck of the bulb within the same. With this construction a flame like that of a candle is manifest upon the electrode f, and a discharge between the same and all parts of the strip d^2 fills the interior of the bulb with light.

In Figs. 6 and 7, the bulb is shown of flattened oval form adapted to insert in a patient's throat. The electrode e^3 is correspondingly shaped, like a flat button, and the coating d^3 is formed in a circular patch upon one of the flattened sides of the bulb concentric with the edges of the button, and connected with the collar c by a strip of the conductive material. With this construction the discharge occurs principally between the electrode e^3 and the disk d^3, but fills the remainder of the bulb with its glow, and the disk serves as a reflector to throw the light outward from the opposite side of the bulb. By confining the conductive coating in a zone to one side

of the bulb, it is enabled to reflect the light outward from the opposite side; but it is obviously immaterial to the production of the discharge upon what part of the bulb the conductive coating is applied. Such coating may be applied to the whole of the lamp if of translucent nature, as the light would then escape in a considerable degree, or the lamp may be wholly coated and openings traced or cut in the same to produce apertures of ornamental design through which the light would escape. Such apertures *l* are indicated in Fig. 4.

I am aware that an exhausted bulb without any coating has been subjected to the electro-magnetic discharge and its interior caused to glow by such means; but such a bulb is not adapted for commercial use, as it is unprovided with any conductive coating, by means of which the discharge may be localized. By coating the bulb with a conductive substance I am enabled to direct the electro-magnetic discharge through the bulb in any desired manner to produce the greatest degree of light with a given expenditure of energy.

It is obvious that many forms can be given to this lamp to adapt it to various uses, and that various phosphorescing materials and various vapors and gases can be introduced in the bulb before finally exhausting the same without departing from my invention.

The lamps illustrated in Figs. 1 to 7 inclusive have been first described because they present the most suitable construction for practical use, as the electro-magnetic discharge takes place more readily between two condenser surfaces having an interposed vacuum and no air space; but the bulb may be formed with only a single conductive body or coating, and the discharge may be secured by placing the bulb in proximity to a surface or body of different potential. Thus, if the conductive body upon the bulb be connected with the positive pole of an electro-magnetic generator, the discharge may be induced by placing the lamp in proximity to any other object which is in electrical connection with the earth; as such object would necessarily be at a lower potential than the conductive body or coating upon the lamp. Such lamps are shown in Figs. 8 and 9, the lamp in Fig. 8 showing the exhausted bulb with the conducting wire *f* insulated by an annular body of air, as in Fig. 1, and a conductive coating d^4 applied to the inner surface of the lamp adjacent to the neck and connected with such conductor. In Fig. 9, a conductive coating d^5 is shown applied to the exterior of the bulb around its neck, and having an electrical connection with a collar *c* which is provided with a positive conductor *f*. A section of a wall *l* is shown adjacent to each of these lamps to represent symbolically any conducting object of suitable potential near which the lamp may be placed. The presence of such an object, when the conductive body upon the lamp is charged with high potential, induces an electro-magnetic discharge or emanation from such body, which, by the rarefication within the bulb is concentrated largely within the lamp and causes the same to glow in the desired manner. It is well known that a mass of iron in proximity to a magnet concentrates the magnetic lines in great degree upon or through such iron, and in like manner the exhausted space within the bulb concentrates the magnetic lines within the bulb when the discharge is produced. The coating d^4 is marked + and the wall in Fig. 8 −, to illustrate the difference of potential between such bodies; but it is obvious that an opposite difference would produce the same effect, and the conductive body d^5 is therefore marked −, and the wall in Fig. 9 marked +.

From the above description it will be seen that the bulb may be provided with the conductive body or coating in a great variety of forms, and is adapted to glow with the electro magnetic discharge by connection with a single wire, as the conductive body upon the lamp furnishes one surface of an electrical condenser which is adapted to operate like any other electrical condenser when brought into suitable proximity to a body of different potential. When the lamp is provided with two conductive bodies or coatings which are charged respectively with high and low potential, the construction embodies all the elements for operating in the most perfect manner; but it is well known that a plain glass surface operates as a condenser surface, so that the inner and outer sides of a glass vessel may be in opposite electrical states, and may therefore operate as condenser surfaces independently of any metallic or conductive coating. In the case of an exhausted glass bulb, the presence of the air upon the exterior of the glass operates as a coating, while the comparative absence of air upon the opposite exhausted side operates to sustain an electrical condition different from that of the exterior. This being true, an exhausted bulb with a coating upon the exterior, and having a single electrical conductor only in contact with such coating, possesses two distinct condenser surfaces, one of which is furnished by such exterior coating, and the other of which is furnished by the inner surface of the glass exposed to the vacuum within the bulb. Similar opposite conditions exist with an inner coating exposed to the vacuum and an outer glass surface exposed to the air.

In all of the constructions illustrated, a condenser surface is exposed to the vacuum; the electrodes *e*, *e'*, e^2 and e^3 furnishing such a condenser surface within the vacuum, and the naked surface of the glass which is exposed to the vacuum furnishing a true condenser surface where no inner coating or electrode is employed.

The essential feature in my invention consists in the subjection, to the action of a varying electro-magnetic or electro-static field, of one condenser surface exposed to the vacuum

of an exhausted receptacle, and another condenser surface exterior to such receptacle and exposed to the air.

My present invention differs from any in which a current is required to pass across the exhausted space, as the latter class of lamps can only be operated with a partial vacuum; while the absolute vacuum is the best medium for the action of the magnetic lines of force and produces an increased efficiency of operation in my construction.

The construction of the electro-magnetic generator and the system of connecting and grouping these lamps are the subjects of other inventions and are not therefore described herein. Such lamps may however be connected either in series or in parallel arc, but operate more effectively when connected in parallel arc.

What I claim herein is—

1. An exhausted bulb having a single conductor only, and a single conductive coating in electrical connection with such conductor through the source of current, as set forth.

2. An exhausted bulb formed with a neck, and provided with a conductive coating upon a portion of the bulbous surface, a contact supporting collar fitted to the neck and electrically connected with such coating, and an electrical conductor connected with such collar, as set forth.

3. An electric lamp, consisting of an exhausted bulb having a conductive coating upon its exterior, an electric conductor extended from the interior to the outside of the bulb, and a second electric conductor connected with the conductive coating, as herein set forth.

4. An electric lamp, consisting of an exhausted bulb having a conductive coating upon its exterior, a conductor extended from the interior to the outside of the bulb, and a lamp support having positive and negative conductors connected respectively with the exterior and the interior of the bulb, as and for the purpose set forth.

5. An electric lamp, consisting of an exhausted glass bulb, an electrode sustained within the same with a conductor leading outside of the same, a conductive coating applied to the exterior of the bulb, and two conductors connected respectively with the electrode and the coating, as herein set forth.

6. An electric lamp, consisting of an exhausted glass bulb, an electrode sustained within the same with a conductor leading outside of the bulb a conductive coating having a reflecting inner surface applied to one side of the bulb, and a conductor leading therefrom as herein set forth.

7. An electric lamp, consisting of an exhausted glass bulb, an electrode sustained within the same with a conductor leading outside of the same, a conductive coating applied to the exterior of the bulb upon a portion substantially concentric with the electrode, and a conductor leading therefrom as herein set forth.

8. An electric lamp, consisting of an exhausted glass bulb having a conductive coating upon its exterior, an electrode supported within the bulb, and a conductor extended from the electrode outside of the bulb and surrounded by an annular body of air, and a conductor leading therefrom as herein set forth.

9. An electric lamp, consisting of an exhausted glass bulb, an electrode supported within the bulb, and a conductor extended from the electrode outside of the bulb, and surrounded by an annular body of air, and a conductive coating in a zone upon the exterior of the bulb concentric with such conductor, as set forth.

10. An electric lamp, consisting of an exhausted glass bulb having a tubular neck encircled by a metallic collar, a conductive coating in a zone about such neck in contact with such collar, and an electrode sustained within the bulb with a conductor extended through the tubular neck, as set forth.

11. An electric lamp, consisting of an exhausted glass bulb having a tubular neck, a glass tube fitted in the center of such neck and hermetically sealed to its outer end, a conductor extended through such glass tube and hermetically sealed to the same at its inner end within the bulb, an electrode upon the inner end of such conductor, and a conductive coating applied to the exterior of the bulb, as set forth.

12. An electric lamp, consisting of an exhausted glass bulb having a tubular neck, a glass tube containing air fitted in the center of such neck and hermetically sealed to its outer end, a conductor extended through the air in such glass tube and hermetically sealed to the tube within the bulb, an electrode upon the inner end of such conductor, and a conductive coating applied to the exterior of the bulb, as set forth.

13. An electric lamp, consisting of an exhausted glass bulb, an electrode sustained within the same by a conductor having a coating of insulating material, fibers of conducting material supported upon the coating of the conductor in contact with the electrode, and a conductive coating applied to the exterior of the bulb, as herein set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

HERBERT COTTRELL.

Witnesses:
L. LEE,
THOMAS S. CRANE.