(No Model.)

3 Sheets—Sheet 1.

E. REYNIER.

Incandescent Electric Lamp.

No. 242,984. Patented June 14, 1881.

Fig. 14.

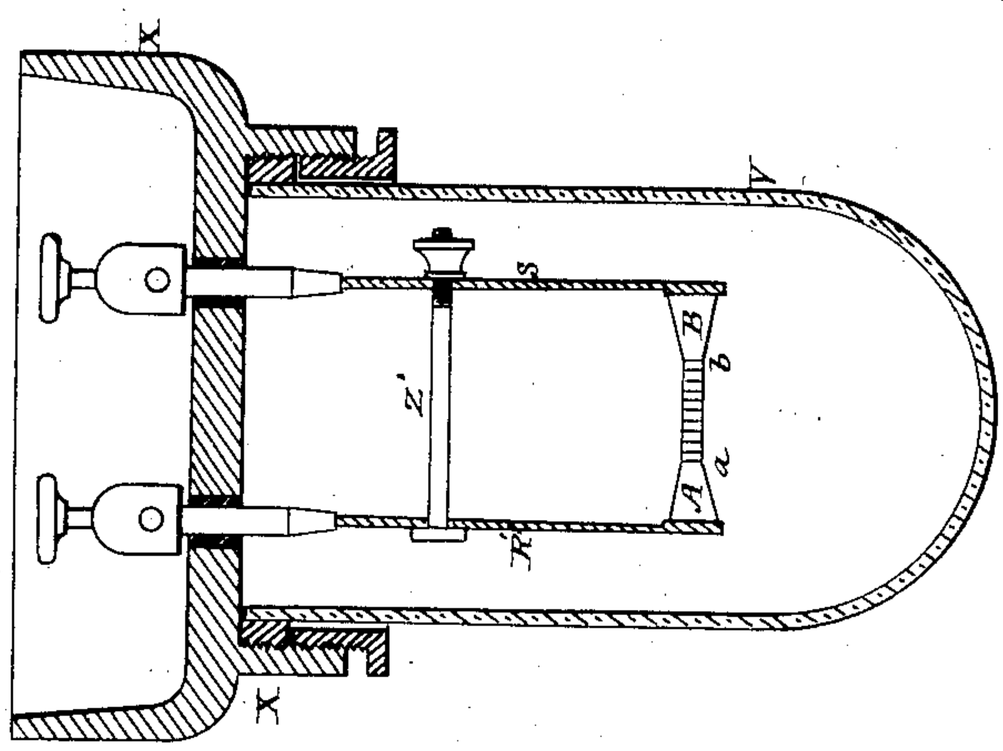


Fig. 13.

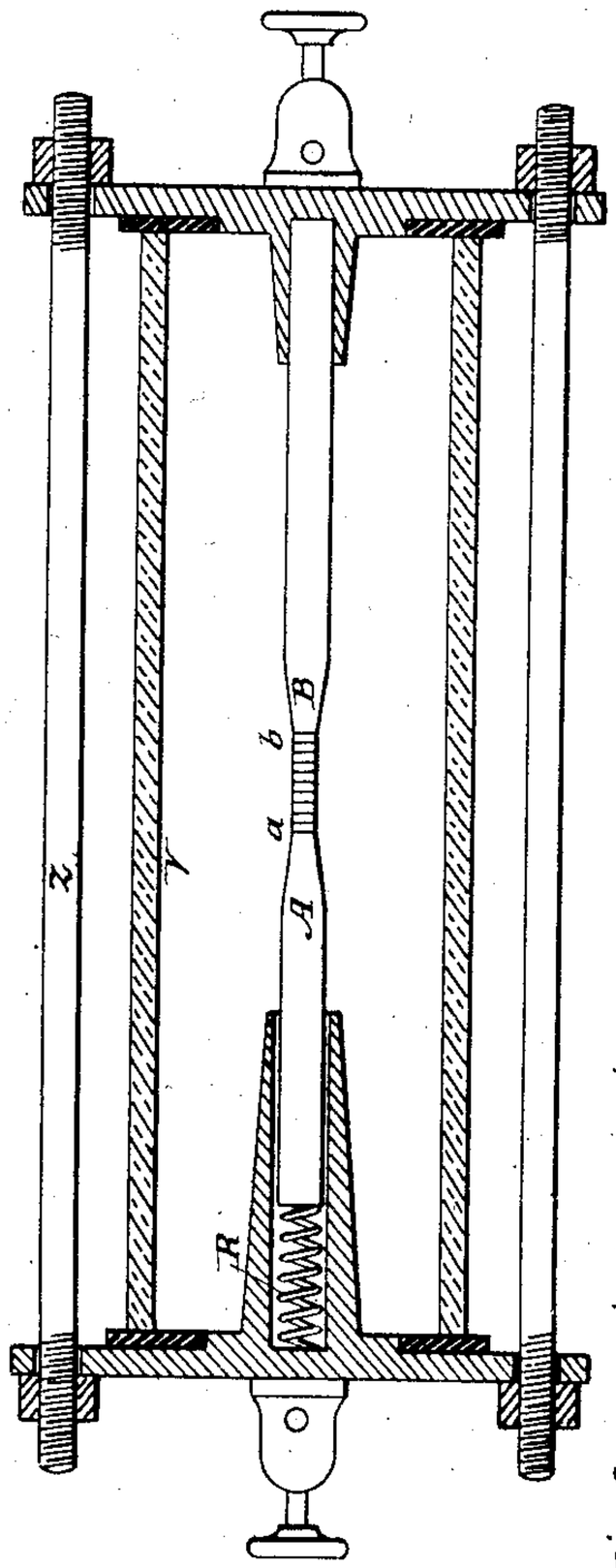


Fig. 11.

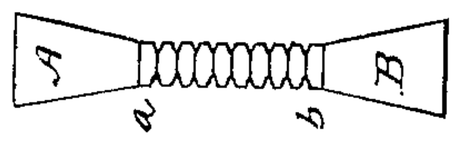


Fig. 10.

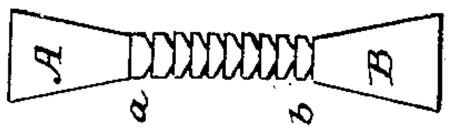


Fig. 9.

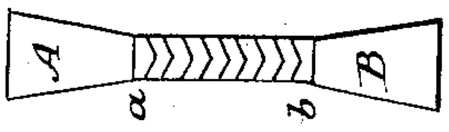


Fig. 8.

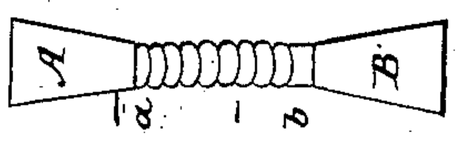


Fig. 7.

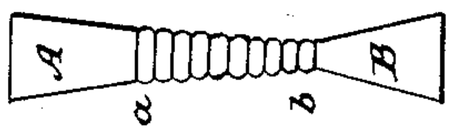


Fig. 6.

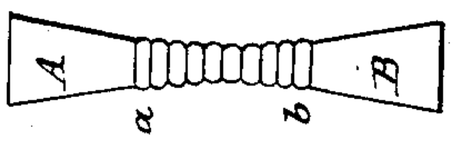


Fig. 5.

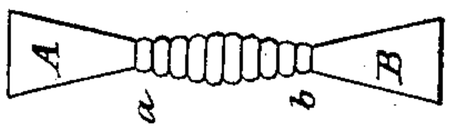


Fig. 4.

Fig. 3.

Fig. 12.

Fig. 2.

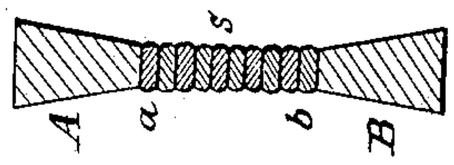
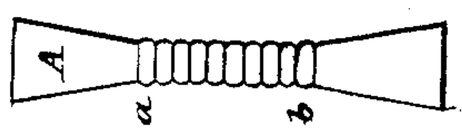


Fig. 1.



Witnesses:

E. E. Masson

C. J. Hedrick

Inventor:

Emile Reynier

by A. Pollok

his attorney.

(No Model.)

3 Sheets—Sheet 2.

E. REYNIER.

Incandescent Electric Lamp.

No. 242,984. **Patented June 14, 1881.**

Fig. 15.

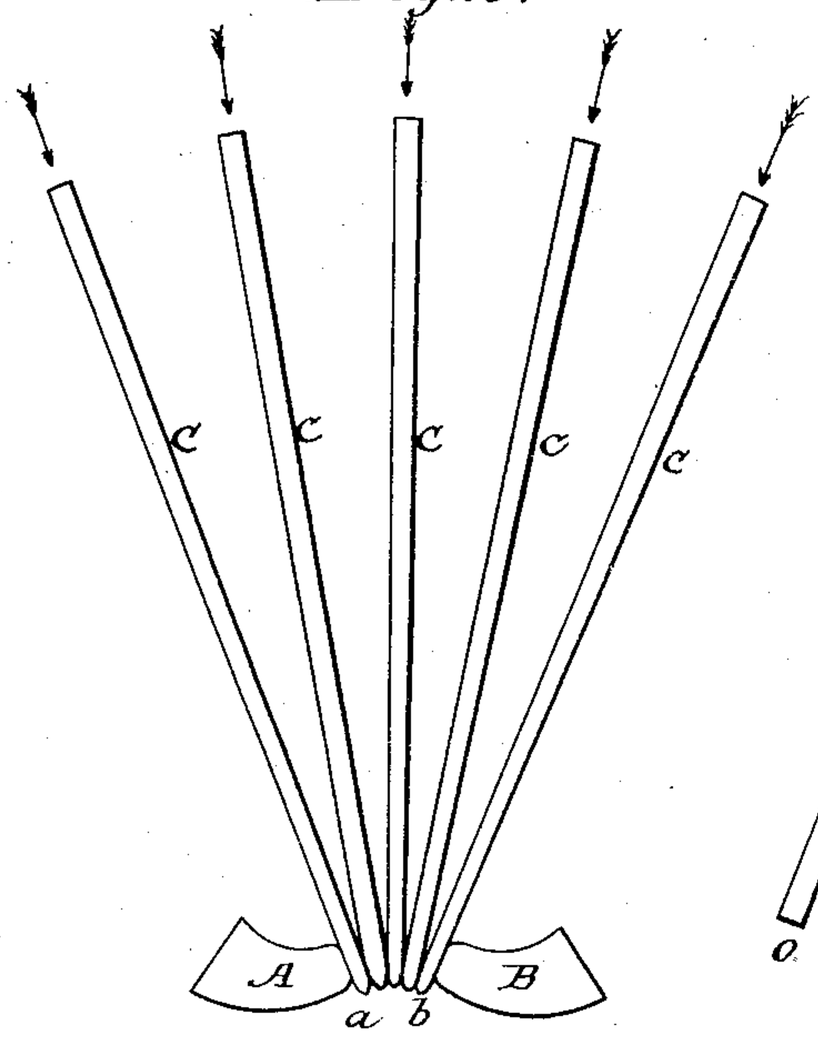


Fig. 16

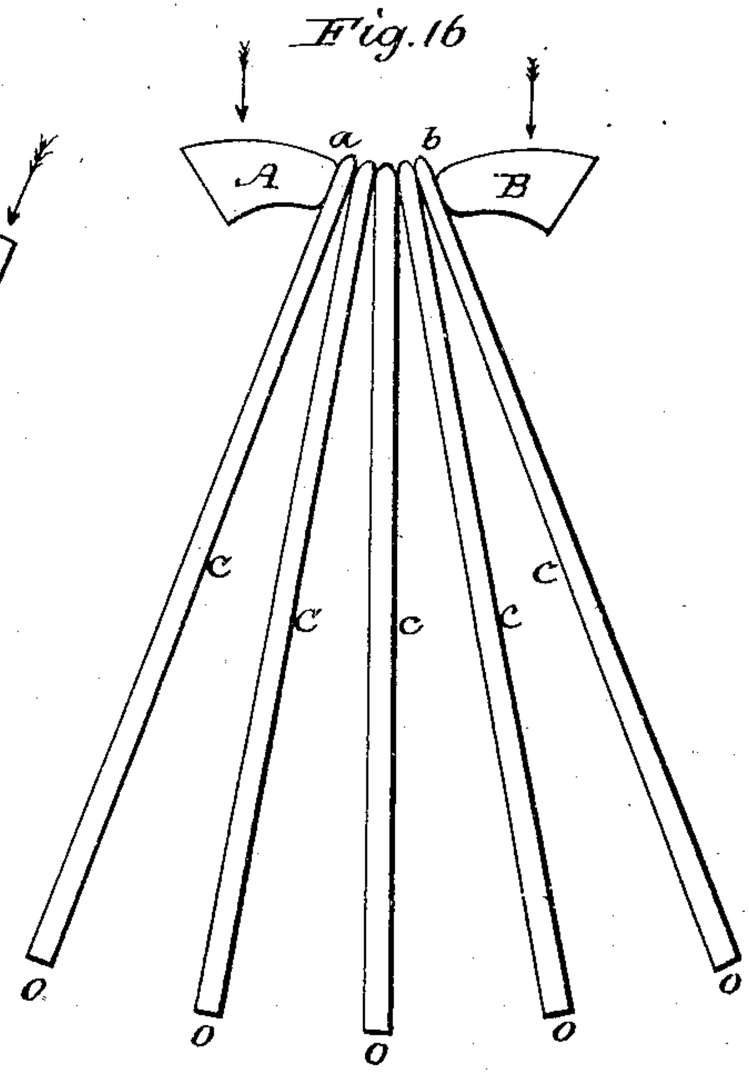


Fig. 22.

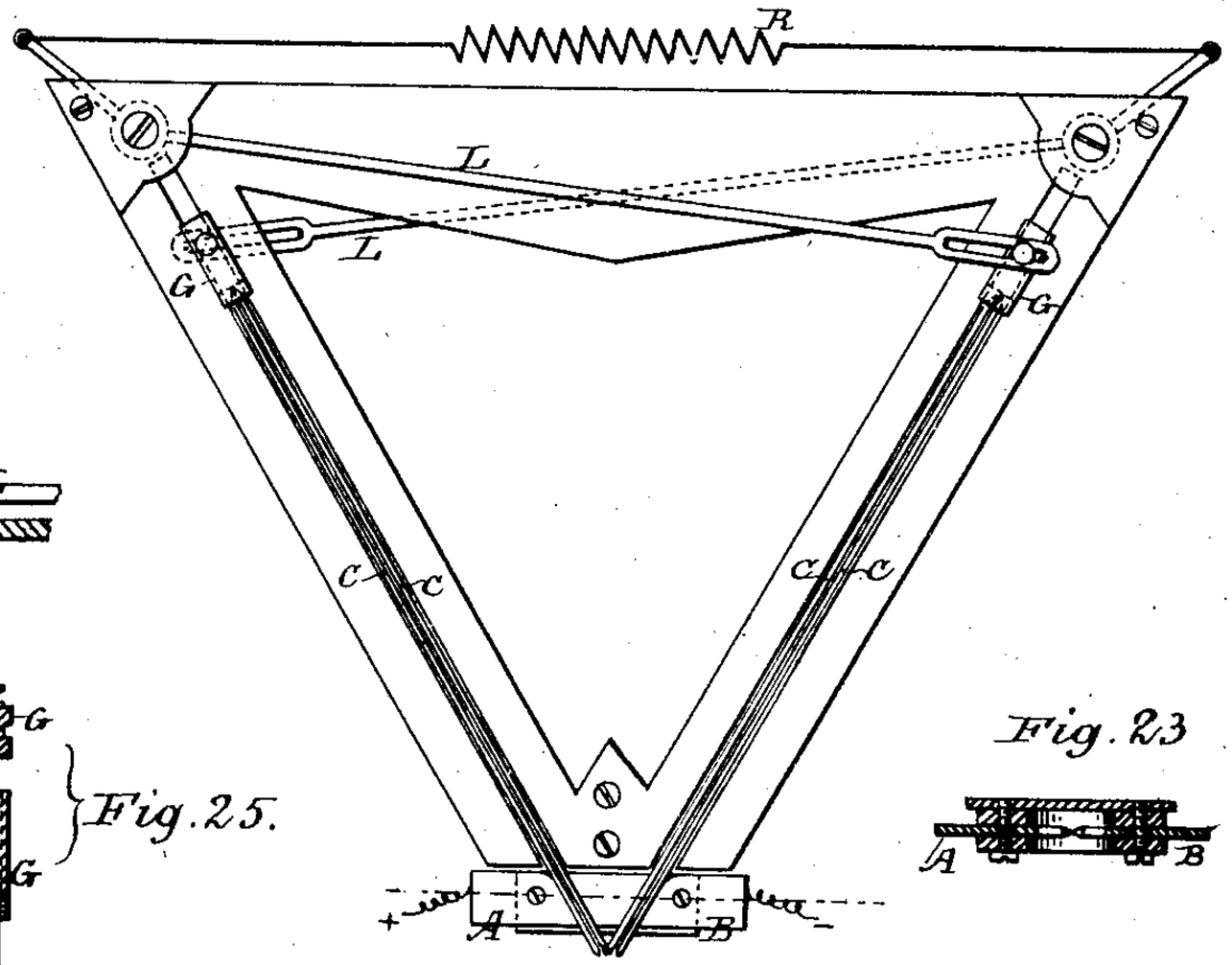


Fig. 24.

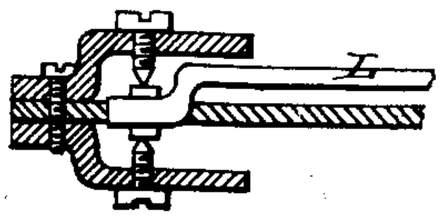


Fig. 25.

Fig. 23

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(No Model.) 3 Sheets—Sheet 3.

E. REYNIER.

Incandescent Electric Lamp.

No. 242,984. **Patented June 14, 1881.**

Fig. 20.

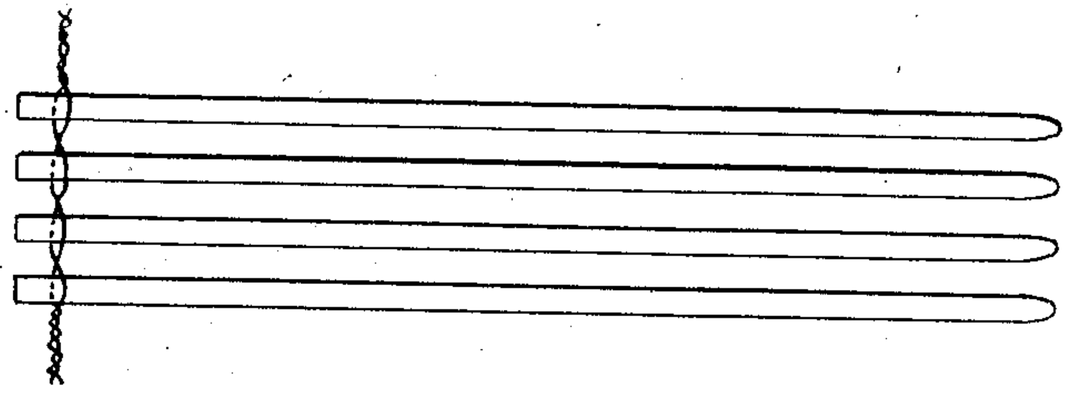


Fig. 21.

Fig. 19.

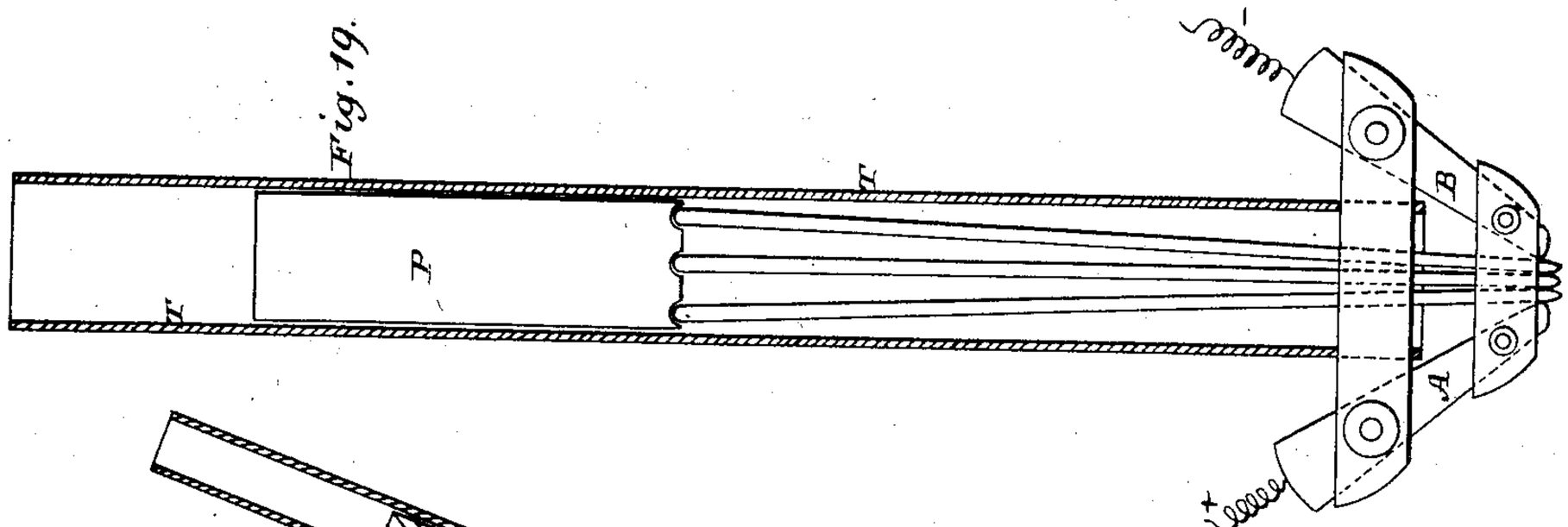


Fig. 17.

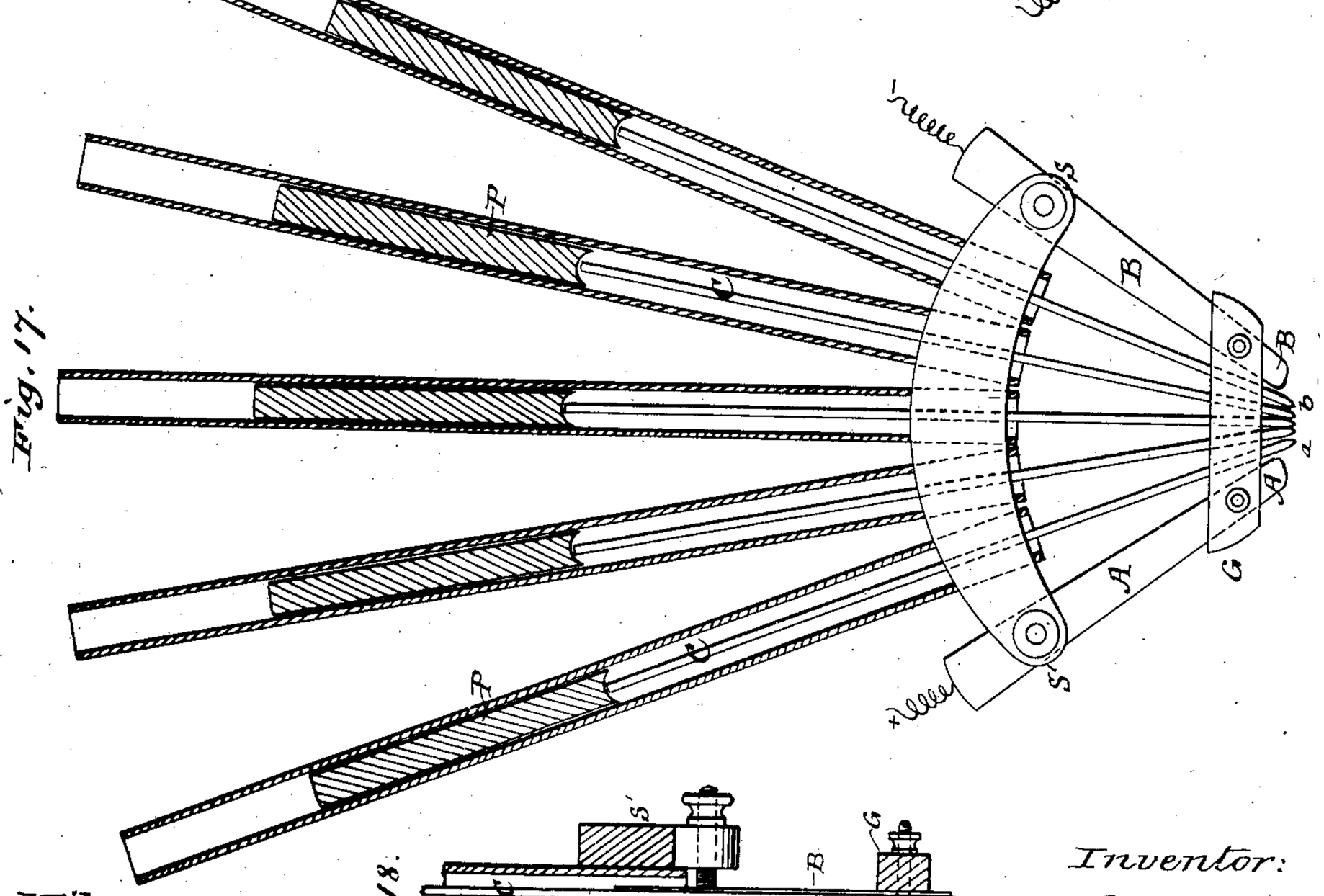
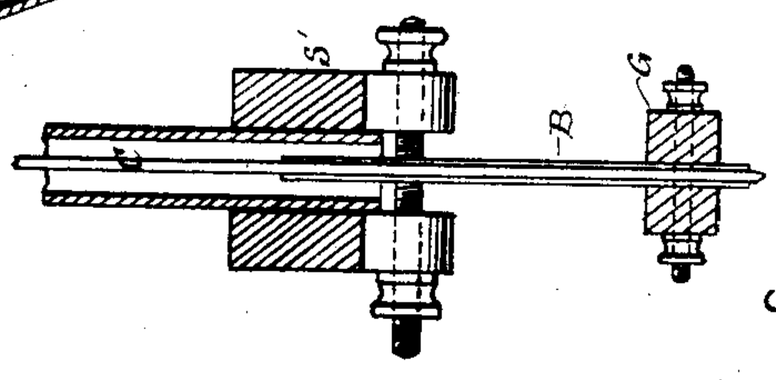


Fig. 18.



Witnesses:
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C. J. Hedrick

Inventor:
Emile Reynier
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his attorney.

UNITED STATES PATENT OFFICE.

EMILE REYNIER, OF PARIS, FRANCE.

INCANDESCENT ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 242,984, dated June 14, 1881.

Application filed April 14, 1881. (No model.)

To all whom it may concern:

Be it known that I, EMILE REYNIER, of Paris, in the Republic of France, have invented a new and useful Improvement in Incandescent Electric Lamps, which improvement is fully set forth in the following specification.

This invention relates to an electric light or electric lamp, having the conductor by the incandescence of which the light is produced composed of a number of blocks or sections, so that the current, in its passage through said conductor, passes across a number of joints or contacts. The term "incandescence" is applied to such lamps to distinguish them from "voltaic-arc" lamps, in which the light is produced by the passage of the electric current between two electrodes separated by a measurable distance; but it is not intended by either name to give expression to an absolute signification, or to particular theoretical ideas. In the same way the term "conductor" is applied to all bodies capable of furnishing a passage to the electric current, although some bodies known as "conductors"—carbon, for example—in certain of their properties resemble the dielectrics.

In an electric lamp the heat developed in a unit of time by a current having the tension of I is proportional to the product E I, in which the difference of potential on opposite sides of the lamp is represented by the factor E. If the value of E is small, as in the early incandescence-lamps of Lodyguine, Rorer, Bouliguine, or Reynier, it is necessary to the factor I large to bring the product E I to the desired value, and in that case, as is well known, large conductors and perfect contacts are demanded by the great intensity of the currents, so that the application upon long circuit of incandescence-lamps of low resistance is very costly. By reducing the section and increasing the length of the conductors, (of carbon or refractory metal,) as some electricians have done, a sufficiently great resistance is obtained, it is true; but the incandescent surface being at the same time increased, the temperature is for an equal expenditure of force less elevated, and the production of light consequently diminished.

The object of the present invention is to produce incandescence-lamps of great resistance without having recourse to the use of long and fine conductors, and this result is obtained by the application to electric lamps of a principle which has not heretofore been usefully applied in the construction of lighting apparatus, and which may be thus stated:

With an electric conductor of any suitable material, form, and dimensions, the effective electrical resistance is considerably increased by dividing it transversely, and this increase of resistance is greater as the sections are more numerous, and as the pressure at the points of contact between the sections is less. With sections very close together a short and not very fine conductor will have a considerable effective resistance, which, nevertheless, will depend upon the proper resistance of the substance or substances of which it is composed—such as graphite, gas-carbon, agglomerated carbon, wood-carbon, carbonized paper, or other organic materials, refractory metals, and the like. This principle can be applied to incandescence-lamps operating without access of air, or to lamps operating in the open air, or in imperfectly-closed vessels.

In the accompanying drawings, which form a part of this specification, some specimens of conductors and of lamps of both these classes are illustrated, and for greater clearness the drawings are, for the most part, on a scale somewhat larger than the natural size. The choice of dimensions, form, and proportions to be given to the apparatus is not, however, limited to what is shown.

Figures 1 to 12 illustrate various forms of conductors for lamps, in which they are protected from the air, Fig. 2 being a sectional view, and the other figures views in elevation. Figs. 13 and 14 are views, in vertical section, of two forms of incandescence-lamps having conductors protected from the atmosphere and made in accordance with this invention. Figs. 15 and 16 are diagrams illustrating the general construction of conductors for incandescence-lamps, made, in accordance with this invention, for use in the free air or in imperfectly-closed vessels. Figs. 17 and 18 are respectively a front view, partly in section, and a vertical section at right angles to the plane of Fig. 17; Fig. 19, a view similar to Fig. 18 of another form of lamp; and Figs. 20 and 21, front and end views respectively of a number of connected rods, forming the two

conductors of a lamp. Fig. 22 is a face view of still another form of open-air lamp; and Figs. 23, 24, and 25 detail views of parts thereof.

In electric lamps having the conductors protected from the atmosphere, since these last indefinitely, it is not necessary to provide for their renewal.

The construction of the sectional conductors is very simple. The first specimen is represented in Fig. 1 in elevation, and in Fig. 2 in section. The incandescent conductor *a b* is divided into a number of sections, *s*.

A B are contact-pieces, and hold between them the sectional conductor, exerting thereon more or less pressure, as may be required. This pressure should not be so great as to crush the sections, nor so small as to allow free spaces to be between them, which either would put out the light or determine the formation of voltaic arcs.

The substance or substances composing the conductors should be very refractory, such as graphite, gas-carbon, agglomerated carbon, wood-carbon, carbonized paper, or other organic material or refractory metal, like iridium, osmium, ruthenium, &c. The contact-pieces are made of the same material, or of somewhat less refractory material, such as platinum.

It is evident that the sectional conductors could be obtained by making or forming separately the several sections of which they are composed and then assembling them, or by making the conductors of one piece and then dividing it. The sectional conductors may be homogeneous or heterogeneous. The transverse sections may be of the same size or of different sizes. The planes of intersection or joints of the conductor can be perpendicular to the general direction of the current, Figs. 1 and 2, or oblique to this direction, Fig. 3. They need not be parallel with each other, Fig. 4; but in no case should they be parallel to the direction of the current.

The specimens of conductors just described are prismatic or cylindrical in form, and are solid or hollow, as may be desired. Practice or experience will, perhaps, demonstrate the utility of giving them forms swelled in the center, Fig. 5, or diminished in the center, Fig. 6, or tapering from end to end, Fig. 7, or other varieties of forms.

The contacts of the different sections with each other can be plane surfaces, as in the examples already given, curved, as in Fig. 8, conical, as in Fig. 9, plano-convex, as in Fig. 10, or double-convex, as in Fig. 11. The two last-named forms of contact have for equal pressure a greater effective resistance than the preceding, in which the adjacent faces are more closely conformed to each other. In Fig. 12 the conductor is arched. A sinuous, irregular, or oblique form can be given to it, if desired. It is obvious that these conductors would operate in any position—horizontal, vertical, or inclined.

In order to indicate by examples the manner in which the sectional conductor is or may be employed, two forms of incandescence-lamps having the conductors protected from the air will now be described.

Referring to Fig. 13, the sectional conductor *a b* is held between the two contact-pieces A B, of which the latter is fixed to the center of the metallic head X, and the former is compressed by a spring, R, and guided in a chamber connected with the metallic head Y. The spring R produces the desired pressure upon the conductor *a b*.

The inclosing-chamber is a cylinder, V, of transparent insulating material, hermetically jointed to the two heads X Y, and held in position by means of several bolts, Z, of insulating material. The two wires from the source of electricity are connected directly or indirectly with the two heads which communicate, respectively, with the two contact-pieces A B. The interior of the chamber is deprived of oxygen, either by combustion produced in it, or by withdrawing the air in any ordinary or suitable way, or by replacing the air with a gas which does not support combustion.

In Fig. 14 the contact-pieces A B are fixed, respectively, to the extremities of the two flexible plates R and S. The pressure upon the sectional conductor *a b* is regulated by means of a bolt, Z', made of insulating material. Plates R and S are prolonged by two bars, which are fastened to, but insulated from, the metallic head X, and the binding-posts for the conducting-wires are connected with them. The air-tight bell-glass *b* is secured to the head X by means of a screw-joint.

Lamps to be used in the free air or in an imperfectly-closed vessel are constructed on the same principle as the preceding; but suitable means are provided for renewing the sectional conductors as they are consumed.

The sectional conductor *a b*, Figs. 15 and 16, is composed of the extremities of a number of converging rods, C, of conducting and refractory material, which are held in contact with each other between the two contact-pieces A and B, so that the current passes transversely through each rod and through its end only. The rods may be of any desired number not less than three.

In the drawings representing lamps of this construction the rods are supposed to be solid, cylindrical, and like each other; but they can be made prismatic or hollow and of different sizes, forms, and materials.

In the sectional conductor thus constituted the renewal, to compensate for the consumption, can be accomplished in two ways: First, the contact-pieces being fixed, the rods can be pushed together or separately into the spaces between these contacts, so as to be advanced as the ends are consumed, their ends being the one against the other, like the voussoir of an arch, of which the contact-pieces are the abutments, Fig. 15; second, the rods being held from endwise movement, the contact-

pieces can be moved in the direction of the arrow, Fig. 16, so as to compress in the space between them the ends of the rods, which latter should be supported by a hinge or flexible or loose connection, so as to be free to oscillate on the points of attachment. The first method is deemed preferable, and is therefore illustrated in the lamps to be now described.

Referring to Figs. 17 and 18, the rods C, of conducting and very refractory material, in number not less than three, are pressed forward individually by weights P, which are guided in tubes or ways, so that their converging ends rest between two contact-pieces, A B. The rods are thus held in a sort of frame, of which the two bars G, of refractory and insulating material, form the sides, and the contact-pieces A B the ends. This manner of guiding several rods into a common frame possesses important advantages. It permits each rod to have individually the movement lengthwise of the frame which is required by the bendings or the chance irregularities of arrangement of the rods, or even the imperfections in the construction of the apparatus. At the same time it prevents all lateral movement, so that the rods, even if very small, cannot be displaced sidewise. The frame, shown as rectangular in plan, can be curved, sinuous, or with non-parallel faces, as in case rods of different sizes are used.

The ends of the tubes or guides *q* for the weights P are fastened to clamps S', of insulating material, to which the two contact-pieces A and B are bolted, so as to support the latter and the bars G. The tubes or guides *q* can be fastened to a suitable supporting-frame in any ordinary way. In Fig. 19 the rods are advanced simultaneously by a single weight, P, working in the tube T. It is well to insulate the ends of the rods against which the motor-weight acts, so as to avoid the formation of branch circuits, which would be very troublesome toward the end of the consumption. In this lamp, as in the preceding, the rods should be introduced one by one—a long and inconvenient operation. This difficulty is avoided by connecting at their upper ends the rods, like or unlike, and of any suitable number, so as to form a multiple conductor, as in Fig. 20, which can be introduced at one time. The rods should be slightly movable in the common binder, so that the points can converge, and they should not be electrically connected through it. To this end the upper parts of the rods are covered with a varnish or insulating mastic, and connected together by a metallic wire or ribbon, interlaced, as shown in plan in Fig. 21. Other methods of connection can be employed. For example, a flexible band of paper, cloth, asbestus fiber, or the like could be used.

It is not essential that the binder should be able to resist a very high temperature. If it burns or melts before the consumption of the rods is complete, the latter will scarcely be disarranged at all, and the lamp will continue to operate properly to the end of its course.

If the sectional conductor is composed of long and fine rods, auxiliary perishable bands, which will be destroyed by the heat, should be employed to sustain them at suitable points between the ends.

In order to permit the introduction from below of the conductors the lamp embouchure or frame for supporting the lower ends of the rods is made movable, or one of the contact-pieces is jointed.

In the lamps shown the rods are advanced downward; but it is evident that they could be made to move in any desired direction, so that the incandescent conductor would keep the proper position.

Instead of using weights to directly advance the rods, counter-weights, springs, watch-barrels, hydrostatic pressure, or other source of mechanical power could be employed.

In Fig. 22 the lamp comprises two groups of two or more rods each. The rods of each group are connected at their upper ends to a slide, G. These two slides are guided in slots in the converging arms of a triangular frame, and are forced downward by a jointed lever, L, connected therewith by a slot-and-pin connection, and acted upon by a spring, R. The lower ends of the carbon converge, and are held between the contact-pieces A B and prevented from lateral movement by a suitable frame of insulating material, as shown in Fig. 23.

It is obvious that parts of this invention can be used without the others, and that various modifications can be made without departing from the spirit of the invention.

Having now fully described the said invention and the manner of carrying the same into effect, what I claim is—

1. A sectional conductor for incandescence electric lamps, the sections of said conductor being transverse to the direction of the current through it, and forming a number of contacts and increasing the effective resistance to the current, substantially as described.

2. The combination, in an electric lamp, of the conductor composed of a number of sections, with the contact-pieces between which said sections are held, substantially as described.

3. A sectional conductor composed of a number of rods having their extremities held between contact-pieces, substantially as described.

4. The combination of the sectional conductor, contact-pieces, and means, as indicated, for holding with yielding pressure the sections of the conductor in contact with each other and with said pieces, substantially as described.

5. The combination of the contact-pieces and converging rods, with their ends held between the said contact-pieces, substantially as described.

6. The combination of the contact-pieces, rods, and means, as indicated, for bringing fresh portions of said rods between the contact-pieces as they are consumed, substantially as described.

7. The combination, with the converging rods, of the guiding-frame having the ends formed by the contact-pieces, substantially as described.

8. In an electric lamp, as described, a number of rods for forming the sectional conductor, bound together by a flexible connection, substantially as described.

9. The combination of the converging rods, guiding-frame having the ends formed by contact-pieces, and one or more weights, springs, or similar devices for advancing said rods, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EMILE REYNIER.

Witnesses:
AUG. PARISOT,
S. VERDIEZT.