

(No Model.)

D. McF. MOORE.

ELECTRICAL ILLUMINATION BY PHOSPHORESCENT FLAME.

No. 548,134.

Patented Oct. 15, 1895.

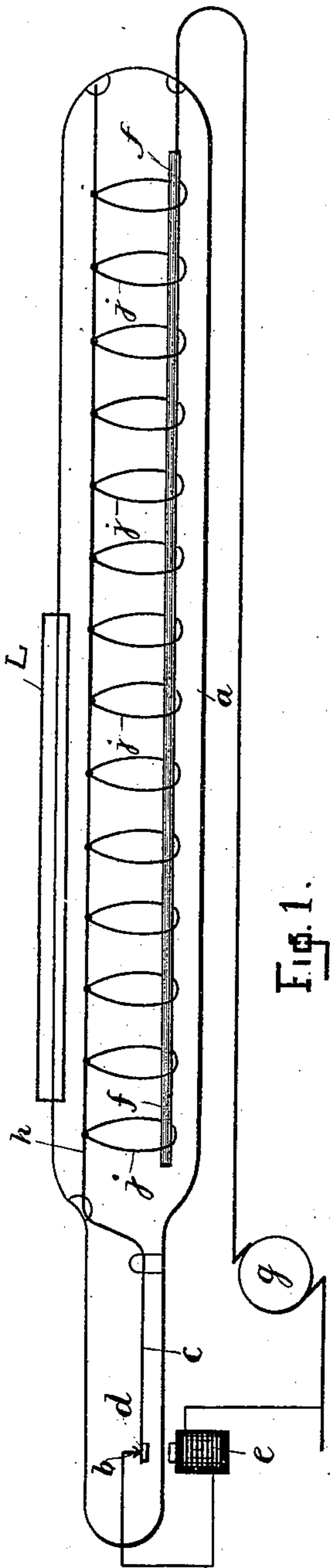


Fig. 1.

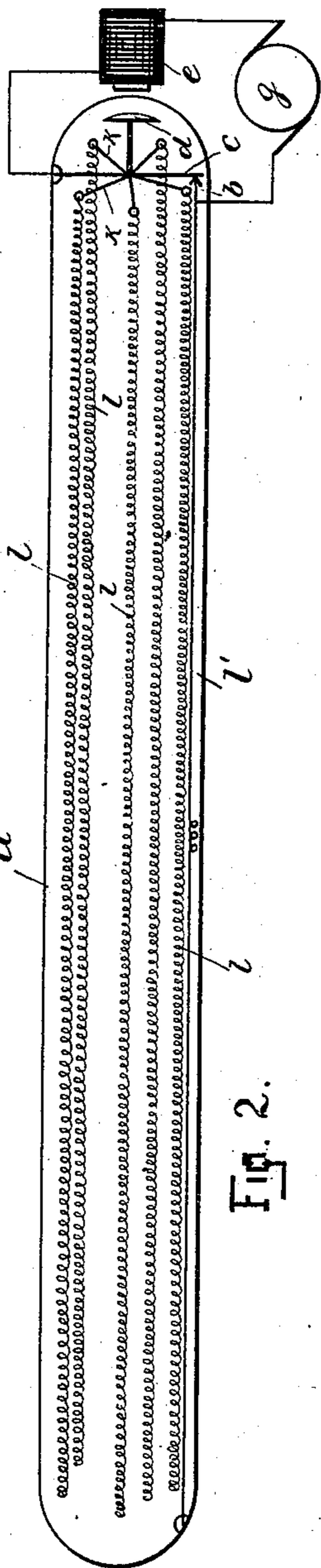


Fig. 2.

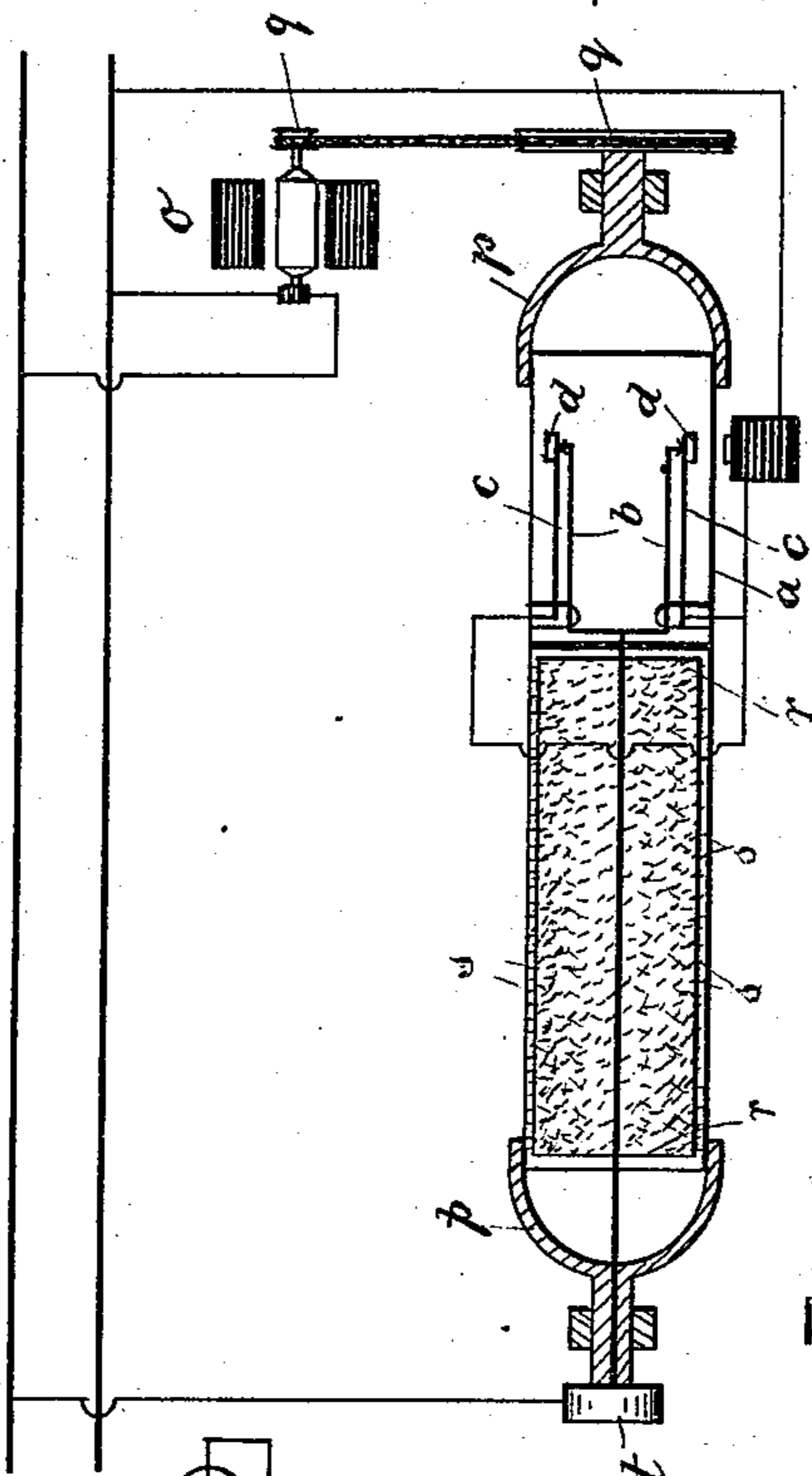


Fig. 3.

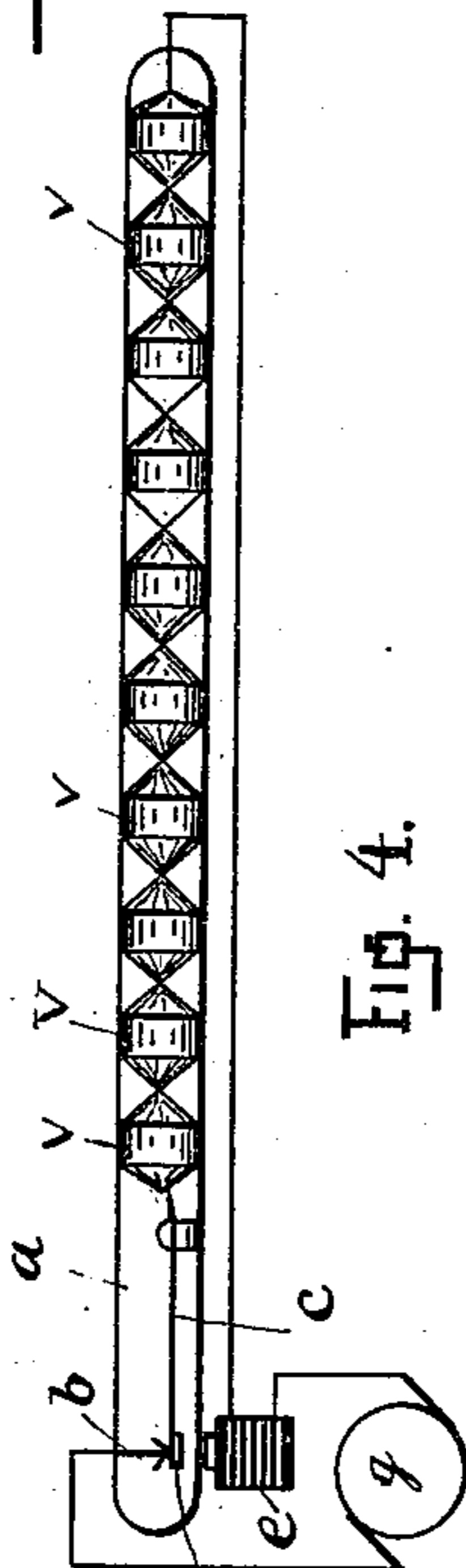


Fig. 4.



Fig. 3a.

WITNESSES:

a. c. Pfaff.  
E. C. Dezhnev.

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# UNITED STATES PATENT OFFICE.

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## ELECTRICAL ILLUMINATION BY PHOSPHORESCENT FLAME.

SPECIFICATION forming part of Letters Patent No. 548,134, dated October 15, 1895.

Application filed January 25, 1895. Serial No. 536,387. (No model.)

*To all whom it may concern:*

Be it known that I, DANIEL MCFARLAN MOORE, a citizen of the United States, and a resident of New York, county and State of New York, have invented certain new and useful Improvements in Electrical Illumination by a Phosphorescent Flame, (Case No. 14,) of which the following is a specification.

My invention relates in general to a production of an electric light by means of the interruption of an electric current within a vacuum and the charging of electric conductors thereby located in the vacuum.

The invention relates more particularly to the formation of phosphorescent light, which I find is produced by a peculiar disposition of the electrical conductors, as hereinafter described.

Figure 1 is an exterior elevation of a device representing my invention. Fig. 2 is an elevation of modified means for producing a phosphorescent flame which has a white light and appears to be incandescent and yet without heat. Fig. 3 shows a modification of that which is set forth in Fig. 2, partially in section. Fig. 3<sup>a</sup> is a cross-section of the frame *r*, which may be compared in shape to an undershot water-wheel. It should be noticed that not only are the little wires *s* luminous independently of the proximity of the same to the glass, but this light is accompanied by the phosphorescent flame. Fig. 4 shows in elevation a modification of the invention.

Referring to Fig. 1, the device consists of a transparent tube *a*, usually constructed of glass and hermetically sealed, having been previously exhausted of air, hydrogen, or the vapors of any liquids which it may have contained, so that it is what is commonly called a "vacuum," but consists of a residual atmosphere. Within the inclosure are vibratory terminals *b* and *c*, one of them being provided with an armature *d*. Within inductive action of the armature is an electromagnet *e*. The terminal *c* is extended by a conductor *h*. A large conductor *f*, which I had made of aluminum, passes through and out of the inclosure and is provided with a circuit-conductor to the electric generator *g*. A conductor *h* follows the conductor *f*, but it may terminate in the end of the tube at *i* and have no return-circuit.

*j* is to indicate loops of wire electrically connected with the conductor *h*. The conductor *f* passes through the loops, and if the generator *g* is of comparatively low electromotive force the conductors *j* are in loose contact at one or more points each with the larger conductor *f*. If the electromotive force of the generator *g* is moderately high—say, a few hundred volts or more—the loops *j* need not actually touch the conductor *f*.

The operation consists in the automatic rapid alternate opening and closing of the terminals *c* and *b*. The effect produced is that within the loops *j* the intensity of the light is so great as to make it appear like a burning flame and impresses an observer so that he would think that the wire *j* was burning. The aggregate number of flames produces a proportional quantity of light. In practice the tube *a* stands vertical longitudinally.

The armature is shown, as before, by the letter *d*, the magnet by *e*, the generator by *g*, the terminals by *b* and *c*. The terminal *c* is made of radial conductors or metallic bars *k*, the ends of which just escape the glass, and they are each extended by fine wires *l*, which either touch the glass very lightly or else just escape it. When the armature is vibrated by the magnet, the terminals *b* and *c* are not only rapidly interrupted, but a close approach to an appearance of incandescence by heat is effected without heat by the interruptions of the touching of the wires *l* and the inner walls of the glass tube *m*. As a great many flames of phosphorescent light occur simultaneously, the average effect is a continuous luminosity. Those wires which may be set in motion by the vibrating armature *d*, which actually come in contact here and there with the glass, produce the flame and are at the same time accompanied by an envelope of light, while the wires *l*, which may not at intervals touch the glass, are also luminous. The wire *l'* increases all the effects by being extended from the other terminal *b* to the other end of the tube, and it may be independent of a return-circuit. This wire *l'* is also luminous.

In Fig. 3, as before, *d* is an armature, *b* and *c* the terminals, and these, it will be noticed, are duplicated, and there need be, however,

but one magnet *e*. When the tube *a* is rotated by means of an electric motor *o*, the respective pairs of terminals are alternately interrupted, causing, as set forth in other applications of mine, a luminosity throughout the tube. For the purpose of rotating the tube around its axis it is held in rotary sockets *p*, driven by the motor *o* through the pulley *q* or in any other well-known manner. *r* represents a wire frame supporting a cloth made of very fine woven wire, which may be assisted in its tensile strength by weaving it in combination with fibrous material, the wires being short pieces of wire, so as to form fringe, (represented by the numerous dots and short lines *s*,) and which just escape the glass. The terminal *b* is extended so as to support this frame *r* and passes on through to the collecting-ring *t*, which in its turn is connected to the main line *u*, while the other terminal of the magnet *e* is connected to the main line *u'*. The motor *o*, of course, may be driven from the same main line. This fringe of fine wires *s* becomes luminous, and also by means of its touching the glass, or almost touching it, incandescent effects are produced, which, being numerous, cause an average and continuous luminosity.

In Fig. 4 the construction is the same as far as the reference-letters correspond to the construction of the vibrator shown in the other figures. *v* represents pieces of conducting material having conical ends, which touch at their points loosely. They simply rest upon each other, or if the tube is tipped they rest on each other more and more loosely until they are only in contact, without practically any pressure when the tube is about horizontal. They are also of such diameter as to be loose in the tubes and yet forming contact therewith, or they may be a little smaller, just so that the contact does not exist. It is evident that from the construction some of them will be a little more pressed against the glass than others and some of them will not touch at all, or at least at only one or two points.

The circuit may be connected up with these carbon pieces, either as shown by letting them form an extended conductor of the terminal *c*, or they may form a portion of the circuit of one of the poles of the generator *g*.

The current having been turned on and the vibrator set in action, the tube *a* becomes a mass of light, for reasons understood in view of the description of the preceding devices.

It is evident that my invention may be modified without departing from the spirit thereof.

*L* represents a conductor located within the evacuated inclosure and insulated from both of the terminals by not being connected with either of the terminals or with any other conductor whatever. It may be held in the inclosure by embedding the ends in the walls of the transparent inclosure. The object of

placing this conductor as represented and as described is to produce additional light by electrical action or disturbance that exists within the inclosure. The conductor is closed upon itself by connecting the ends outside of the inclosure.

I claim as my invention—

1. An electric phosphorescent flame producer consisting of the combination of an evacuated inclosure, movable terminals of an electric circuit therein, and electric conductors of similar polarity and connected to one of the terminals and extending through the evacuated space and in loose contact with each other at points.

2. An electric phosphorescent flame producer, consisting of the combination of an evacuated inclosure, movable terminals of an electric circuit therein, electric conductors of similar polarity connected to one of the terminals and extending through the evacuated space, one of the conductors being larger than the other and surrounded by wire loops which are connected to the other conductor of the same polarity.

3. The combination with an evacuated inclosure, of a conductor located therein and in an electric circuit and divided up into parts which are in loose contact with one another, and means for opening and closing the said circuit within the vacuum.

4. An electric phosphorescent flame producer consisting of the combination of an evacuated inclosure having electrodes therein, one of which is divided up into parts which are in loose contact.

5. An incandescent phosphorescent electric illuminator, consisting of the combination of an evacuated inclosure, terminals of an electric circuit therein, between which an electric spark may be formed and means for bringing one of the terminals in and out of contact with the inner walls of the inclosure.

6. An incandescent phosphorescent electric illuminator, consisting of the combination of an evacuated inclosure, terminals of an electric circuit therein, between which an electric spark may be formed, and means for bringing one of the terminals in and out of contact with the inner walls of the inclosure at a multitude of points.

7. An incandescent phosphorescent electric illuminator, consisting of the combination of an evacuated inclosure, terminals of an electric circuit therein, and means for bringing an extension of one of the terminals in and out of contact with the inner walls of the inclosure at a multitude of points.

8. An incandescent phosphorescent illuminator, consisting of the combination of an evacuated inclosure, electric terminals therein, between which an electric spark may pass and one of which has vibratory flexible conductors extending from the vibratory terminals in loose contact at a multitude of points, with the inner walls of the inclosure, and means for vibrating the vibratory terminals.

9. An incandescent phosphorescent illuminator consisting of the combination of an evacuated inclosure, electric terminals therein, between which an electric spark may pass  
5 and one of which has vibratory flexible conductors extending from the vibratory terminals in loose contact at a multitude of points with the inner walls of the inclosure, means for vibrating the vibratory terminals and an  
10 extension from the other terminal parallel to the first named extended terminal and located within the inclosure.

10. The combination of an evacuated inclosure having vibrating electric terminals  
15 therein and located in an electric circuit, of a conductor L located within the inclosure within inductive action of the terminals or one of them and insulated from said circuit.

11. The combination of an evacuated inclosure having vibrating electric terminals  
20 therein and located in an electric circuit, of a conductor L located within the inclosure within inductive action of the terminals or one of them and closed upon itself and insulated from said circuit.  
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12. The combination of an evacuated inclosure having vibrating electric terminals therein and located in an electric circuit of a conductor L located within the inclosure and  
30 within inductive action of the terminals or one of them and insulated from said circuit.

13. An incandescent phosphorescent illuminator consisting of the combination with an evacuated inclosure, of a vibratory terminal, an electric circuit within sparking distance of the terminal of opposite polarity and flexible wires suspended from the vibratory terminal and extending parallel to the wall of the inclosure.  
35

40 14. The combination with an evacuated tube, of electric terminals within sparking

distance of each other, and pieces of carbon having pyramidal ends in loose contact with one another and connected electrically with one of the electric terminals.

15. The combination with an evacuated inclosure, of electric terminals within sparking distance of each other, pieces of carbon having pyramidal ends in loose contact with one another and connected electrically with one  
50 of the electric terminals, and means for vibrating the terminals to and from each other.

16. An incandescent phosphorescent illuminator, consisting of the combination of an evacuated tube having pieces of carbon in  
55 loose contact with one another and with the tube and connected in the circuit of an electric generator, and means for producing interruptions or partial interruptions of the circuit within the tube.

17. The combination with an evacuated inclosure of electric terminals therein within sparking distance of one another, a woven wire having its ends cut at the surface and edges and within sparking distance of the wall  
65 of the inclosure, and means for rotating the inclosure.

18. The combination with an evacuated inclosure, of electric terminals therein within sparking distance of one another, a woven  
70 wire having its ends cut at the surface and edge and within sparking distance of the wall of the inclosure, and means for jarring the inclosure.

In testimony that I claim the foregoing as  
75 my invention I have signed my name, in presence of two witnesses, this 22d day of January, 1895.

D. MCFARLAN MOORE. [L. S.]

Witnesses:

EDWARD P. THOMPSON,  
ROBERT S. CHAPPELL.