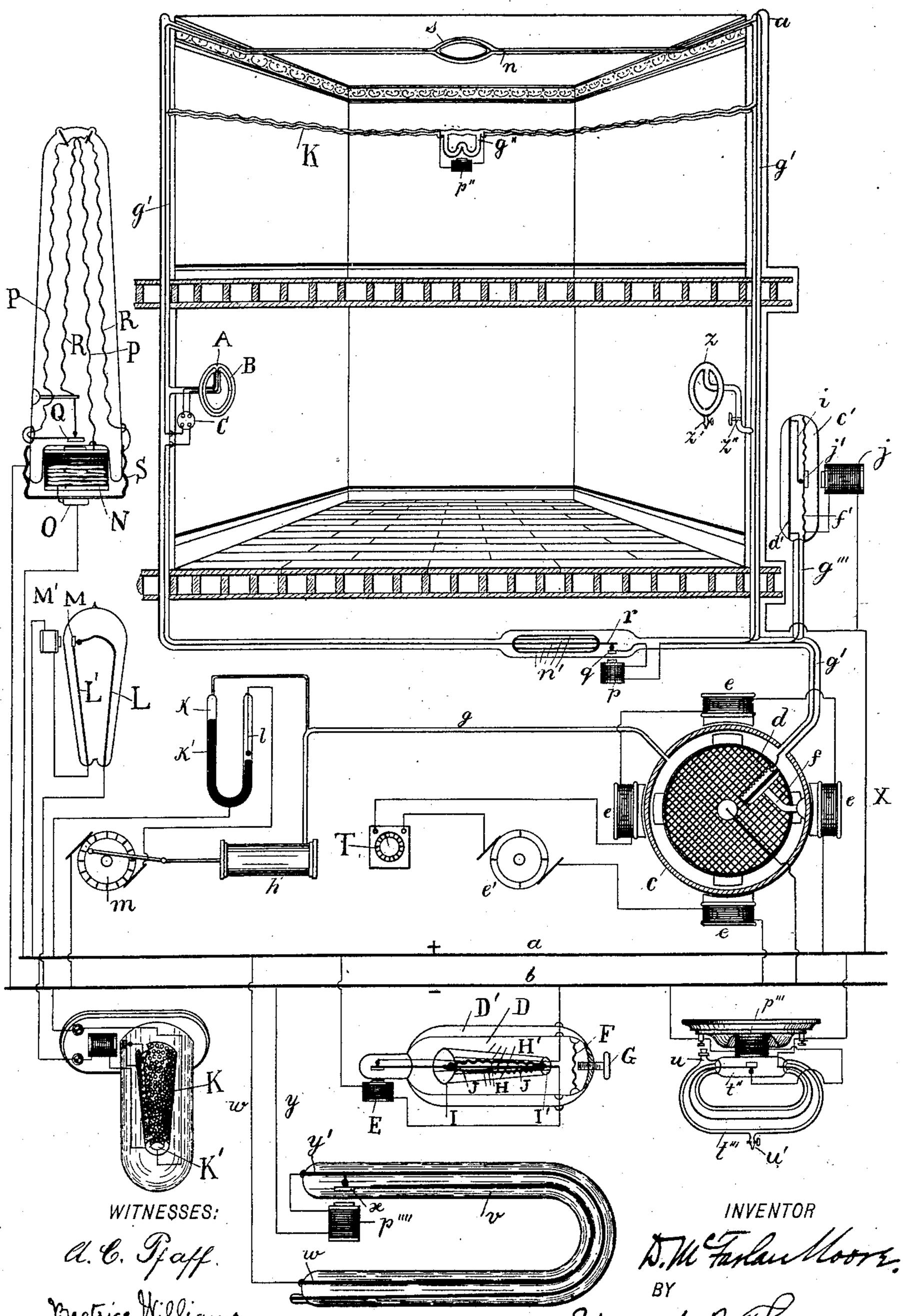
(No Model.)

D. McF. MOORE.

ELECTRICAL ILLUMINATION.

No. 548,126. Patented Oct. 15, 1895.



WITNESSES:

A. C. Pfaff.

Beatrice Williams.

INVENTOR

D. McF. Moore.

BY

Edward P. Thompson

ATTORNEY.

UNITED STATES PATENT OFFICE.

DANIEL McFARLAN MOORE, OF NEW YORK, N. Y.

ELECTRICAL ILLUMINATION.

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To all whom it may concern:

Be it known that I, DANIEL MCFARLAN MOORE, a citizen of the United States of America, and a resident of New York city, in the county and State of New York, have invented certain new and useful Improvements in Electrical Illumination, of which the following is a specification.

The object of my invention is to obtain electrical phosphorescent illumination in an evacuated space without the aid of static electricity or Ruhmkorff induction-coils and by the use solely of an ordinary commercial current—such as, for example, that employed in running the usual incandescent electric lamps or such as that which would be obtained directly from a few cells of a galvanic battery. The object, further, is to obtain a greater intensity of light, to accumulate it at points, and to regulate the intensity of the light obtained.

Heretofore it has been common to produce what is known as the "Geissler tube effect" between electric terminals within an evacuated space. When the space between the terminals is large, a high potential is needed to break it down. I have overcome this difficulty by putting the terminals in touching contact and breaking the contact by given means. In this way I am enabled to obtain the luminosity with very low voltage. The vacuous space between the terminals is practically dispensed with and the phosphorescent light extends through the entire volume of the tube.

a and *b* are respectively the positive and negative conductors of a main line for conducting an electric current from an external source of energy—as, for example, a dynamo A. The positive nature of the one conductor is represented by the plus sign and the other by the negative sign.

The means for interrupting the current within the vacuum consist of the combination of an evacuated cylinder *c*, containing entirely within itself a rotary and irregular conductor *d*, made, for example, of wire-gauze, and provided with armatures which are within inductive action of magnets *e*, located outside of the cylinder and in circuit with a suitable commutator *e'*, a brush *f* in contact with the wire-gauze and adapted to permit the same to slide over it loosely, a tube *g*, passing from the cylinder to the air-pump *h*, and a second tube *g'*, passing from the said cylinder to different portions of the building. The tube *g'* extends throughout the building, and the negative main line *a* is connected at the top of the building with the tube *g'* and passes in a subdivided manner through the tube, which is itself also subdivided and connects with the brush *f*.

The commutator *e'* has segments B, in length about one-sixteenth of the circumference, so as to close the current through the magnets *e* during very short times of each rotation of the commutator *e'*, which is turned rapidly by some mechanical force. At each impulse of current the armatures in the vacuum-chamber *c* are attracted except at dead-centers. The momentum carries the armatures past the magnets to near the next magnets in order, which being again closed for a short interval propel the armatures again, and so on, producing rotation. This means of causing the rotation may be replaced by others well known in the art, the above being no part of my invention, and being represented briefly merely to indicate the idea roughly that the gauze *d* is to be rotated.

The vacuum in the tubes is maintained by means of the automatic arrangement in connection with the pump *h*, and consists of a closed U-tube *k*, containing mercury, which only partially fills it. The pump *h* is connected with one arm of the U and an electric terminal enters the other arm. Assuming that the vacuum is of the proper rarity, the terminal *l* in the U-tube should just escape the surface of the said mercury *k'*. When the vacuum becomes abnormally low to a very small extent, the mercury *k'* comes in contact with the terminal *l*, which is in circuit with an electric motor *m*, while the mercury and motor are also in circuit with the main lines *a* and *b*. Therefore when the mercury and the said terminal *l* come together the motor *m* is operated, the pump *h* is worked, and the vacuum is brought up to the standard again.

When the current is passed through the generator at X, before described, the gauze *d* rotates very rapidly against the brush *f* and produces a multitude of interruptions, causing an electrical illumination, which extends

into, up, and throughout the tube g', and is augmented from the fact that the negative wire, which is lettered a, passes throughout the tube, and is further augmented in any part of the system by subdivision of the wire into many parts, as by those lettered n' in the enlarged portion of the tube. It is preferable to have a spark-producer or vibrator at the numerous subdivisions n', and therefore there is provided a magnet p, which is within inductive relation of the armature q of the vibrator. The armature q is located within the vacuum and magnet p without, but within inductive relation thereto, and the armature is vibratory, so that it can make and break the circuit at the terminal r.

Another illustration of the manner of subdividing the wire is shown on the top of the coiling in the upper room at s, which represents a tubular ring connected at opposite sides with portions of the tube g'. The wire n subdivides, so that one part passes around half of the ring in the tube and the other part through the other half of the ring in the tube. Of course the vibrator having the magnet p produces light in addition to that which is transmitted thereto by the tube g' from the generator at X.

Inasmuch as light exists in and throughout the tube g', it is desired that the tube may be tapped in a magnetic manner, so as to bring some of the light into the room. One means of doing this is illustrated at the magnet p'' and the loop-tube g''. The operation of this feature consists in that the magnet p'' bends the light from its course and causes at least a portion of it to pass through the loop g'' and to assist in illuminating the room. At the magnet p''' is a vibrator like that at p', except that the tube t'' is an independent vacuum-tube and has a portion of it surrounded by a concentric tube t''', which is filled with a colored liquid, which may be entered at the nozzle u and emitted at the nozzle u', and it is in view of this construction that the color of the light may be varied without limit by entering liquids of different colors successively. In order to increase the light throughout the tube t'', the negative wire runs through the same.

The light that exists in the evacuated space is also augmented by not only passing the negative wire throughout the tube, but also producing induction between it and the inductive wire, which should also be extended to the end of the tube. This is illustrated first in the device at the magnet p''''. The tube for illustrating this is shown in the form of a U and is lettered v. The negative wire in this case is lettered w and passes through the length of the tube, terminating with the vibratory armature x, adapted to break the current of the positive terminal y, which has an extension y' passing through the tube v throughout its whole length.

Induction accompanied by light occurs between the two conductors w and y' within the tube v, which is exhausted to the proper degree.

In order to perfect the system I have invented means for regulating the light at desirable points. For example, the pipe g' may be attached so as to feed the small glass tube z, provided with two valves, the one z' communicating with the outer air and the other z'' communicating with the tube g'. The light in the tube x may be entirely extinguished by only slightly opening the valve z', previously closing the valve z'', so that the vacuum of the whole system may not be injured, but only that in the tube z. Furthermore, the light in the tube z need not be entirely extinguished, but may be varied by manipulating the valves z' and z'', so as to only slightly vary the degree of the vacuum therein. The regulation may take place also by means of cutting out a section of the negative wire which passes through the vacuum-tubes. This is illustrated at the tube A, containing a wire B, adapted to be cut in and out of circuit with the negative wire by means of the four-pole switch C. The light is at its maximum when the wire D is in circuit, and it is reduced to a lower candle-power by means of the four-pole switch C. I also illustrate how the light may be varied by means of varying the pressure of the atmosphere constituting the high vacuum. This is illustrated by the individual vacuum-bulb D, which contains the vibrator whose magnet is E, and which is provided with a corrugated and flexible and elastic plate F, closing the interior from the exterior atmosphere and adapted to be pushed inward and outward by the screw G, so that the pressure of the internal atmosphere is varied, and consequently the light. The lamp to which this is attached is also an illustration of the increase of light by means of induction between the positive and negative wires, the former being subdivided into several parts and also the inductive wire being subdivided into numerous parts H′ and supported upon two conducting-rings I and I′, the latter being smaller, so that the wires H′ will be nearer and nearer the wires H the farther they are from the vibrator, so that the light will be more evenly produced throughout the tube D. The vacuum in the tube D is further protected by an outer envelope D′, which is also exhausted. Instead of subdividing the wire into the parts H, the same may be provided with corrugations J or similarly roughened in order to increase the radiating-surface.

To illustrate that the tube g' may itself be employed for the purpose of radiating useful light, a branch K is shown going around the wall of the upper room. Extending from the tube g' is a branch tube g''', terminating in a bulb c', containing two substantially-parallel conducting-plates f' and d', respectively negative and positive, and the former carrying an armature j' and being vibratory with relation to an electric terminal i, which is in

loose contact therewith. The magnet *j* is within inductive relation to the armature *j'*, and the terminal *i* is electrically connected to the plate *d'*.

In another modification of the invention I substitute carbon filaments for those portions of the conducting-wires that are inside of the bulb. The carbon filaments are lettered L and L'. Upon the end of the filament L' is the armature M, and the end of the other filament L is so arranged that the armatures can vibrate to and from it. The magnet is lettered M' and is within inductive relation to the armature. When this part of the invention is in operation, light is produced not only upon the phosphorescent principle, but also by the incandescence of the carbon filaments. There is also a certain kind of induction which takes place between the filaments L and L'.

At the magnet N is an evacuated bulb having the conductors corrugated, and the positive and negative terminals are parallel to each other and extend up and down throughout the vacuum, the circuit being traced as follows: from the lamp-terminal O throughout the magnet N, through the conductor P, to the armature Q, to the conductor R, and to the socket-terminal S.

K and K' are cylinders (the outer perforated) in the place of the split conductors H and H'.

T is a rheostat for varying the rapidity of the sparks.

Of course the tube *g'* or bulb *c* or other parts of the vacuum-chamber may be opaque.

The light which is produced in the evacuated space by means of my invention occurs throughout the evacuated space if the vacuum is rather high and is more intense immediately around the wires. If the degree of density of the rarefied atmosphere is greater, the glow occurs practically only around the wires in the nature of an outward concentric tube of light. The sparks between the terminals during interruptions of the current are visible as by minute yellow sparks, as would be found in the terminals of an electric-bell vibrator, only greatly reduced, because of the vacuum not permitting combustion to take place.

I claim as my invention—

1. A system of electrical phosphorescent illumination, consisting of an evacuated inclosure, a tube communicating therewith and extending to distant points, an electric generator, electrical conductors extending therefrom and passing through the evacuated space, and means for making and breaking the circuit within the vacuum.

2. A system of electrical illumination consisting of the combination of an evacuated bulb hermetically sealed containing entirely within itself an irregularly constructed and rotary electric conductor carrying armatures, means for rotating the armatures, an electric brush in contact with the said conductor, a sub-divided tube extending to distant points and carrying a wire which enters the tube at a distant point, passes through the same and connects with said brush; vibratory contacts located at distant points in said tube and magnets for vibrating said contacts and included in circuit with said wire.

3. The combination with an evacuated bulb of means for making and breaking an electric circuit within the vacuum, a tube extending therefrom and communicating with an air pump, an electric motor for driving the pump and means for automatically closing the circuit through the motor when the vacuum falls below a predetermined degree.

4. The combination with an evacuated bulb of means for making and breaking an electric circuit within the vacuum, a tube extending therefrom and communicating with an air pump, an electric motor for driving the pump, and means for automatically closing the circuit through the motor when the vacuum falls below a predetermined degree, said means consisting of a closed U tube containing mercury, having one arm connected with the pump and having a terminal of the motor located in the other arm of the tube, and just out of contact with the mercury when the vacuum is high, the mercury being electrically connected with the other terminal of the motor.

5. The combination with an evacuated bulb of means for closing and separating negative and positive electric terminals, a tube extending to distant points and communicating with the bulb, a wire passing into the tube at a distant point to the positive terminal, and a second wire passing into the bulb to the negative terminal and an electric generator connecting with both wires.

6. The combination with an evacuated bulb of means for making and breaking an electric circuit within the vacuum, a tube forming a branch to the bulb and provided with valves, one of which communicates with the outside atmosphere and the other with the bulb.

7. The combination with an evacuated bulb of vibratory electric contacts therein, a tube extending therefrom and carrying that wire which connects with the negative contact and means for cutting in and out a portion of the wire which is located within the tube.

8. The combination with an evacuated bulb having a stopper consisting of a flexible, elastic and corrugated plate and containing vibratory electric contacts, of means for bending the said plate.

9. The combination with an evacuated inclosure, of a conductor therein so formed that the electric field of force surrounding one part of the conductor intersects the field of force surrounding another part of said conductor, and vibratory electric contacts connected to an electric generator and also one of them to said conductor.

10. The combination with an evacuated bulb containing vibratory electric contacts, of

a wire passing to the negative terminal and a second wire extending from the negative terminal, the two wires being within inductive action of each other.

11. The combination with an evacuated bulb, of a tube having a loop thereto, vibratory electric contacts located within the tube and an electro magnet outside of the loop and within inductive action of the electrical and molecular disturbance within the tube.

12. The combination with an evacuated inclosure, of a conductor therein arranged to form a cage inclosing a portion of the evacuated space, and electrically connected to one of the members of a pair of given make and break terminals of an electric generator.

13. The combination with an evacuated bulb of vibratory electric contacts therein, and an electric conductor having a roughened surface extending from the negative contact through the bulb to one pole of the electrical generator while the other contact extends to the other pole of the generator.

14. The combination with an evacuated glass tube containing vibratory electric contacts of a concentric and outer tube containing a colored liquid and means for filling and emptying the last named tube.

15. The combination with an evacuated bulb provided with vibratory electric contacts of sub-divided electric conductors extending from the above contacts and tapering toward each other in a direction away from the said contacts.

16. The combination with an evacuated bulb of a magnet outside and its armature inside arranged to be an electric terminal and to vibrate an electric terminal of opposite polarity and carbon filaments within the bulb and connecting said terminals with an electric generator.

17. The combination with an evacuated bulb, of vibratory contacts located therein, and provided with an armature, an electro magnet without the bulb and within inductive relation to said armature, and positive and negative conductors passing from without the bulb into and back and forth within the same and connected to said contacts, and parallel to each other.

18. The combination with an electric generator and with an evacuated bulb, of electric terminals therein, and carbon filaments therein and connecting said generator to said terminals and means for vibrating the said terminals to and from each other.

19. The combination with an evacuated tube extending to distant points, of a conductor extending longitudinally through the tube and carrying an electric current, and means for rapidly interrupting the current at points within the tube, the atmosphere of the inclosure being in density such that light is generated at all points of the vacuum.

20. A phosphorescent illuminator consisting of the combination with an evacuated inclosure, of an electric conductor passing into and out of the same and extending, as to its negative portion, through the evacuated space, and means for alternately interrupting and closing the conductor.

21. A phosphorescent illuminator consisting of the combination of an evacuated inclosure, electric terminals therein and included in an electric circuit and means for moving the same to and from each other, the atmosphere of the inclosure being in density such that light is generated at all points of the vacuum.

22. A phosphorescent illuminator consisting of the combination with an evacuated inclosure, of terminals therein of an electric generator, and means outside of the vacuum for vibrating the terminals to and from each other.

23. A phosphorescent illuminator, consisting of the combination of an evacuated U tube, vibratory electric terminals therein normally in contact with one another and provided with an armature, a magnet outside of the tube and within inductive relation to the armature and in circuit with the said terminals and an extension conductor, y', from one of the terminals passing throughout the length of the tube and terminating therein independently of a return circuit.

24. The combination of electrodes within an evacuated inclosure, forming respective extensions from vibratory electric terminals, and a generator whose poles are respectively connected to said terminals, and means outside of the vacuum for vibrating the terminals.

25. A phosphorescent illuminator consisting of the combination of an evacuated inclosure, vibratory electric contacts therein, means for vibrating the contacts to and from each other, and a subdivided electric conductor whose portions are parallel to each other, extending from one of the contacts through the evacuated space and in circuit with the contacts.

26. A phosphorescent illuminator consisting of the combination of an evacuated inclosure whose opposite walls are connected by substantially parallel electric conductors, f' and d', whose corresponding lower ends are connected to the terminals of an electric generator, an oscillatory electric conductor, i, connected to the upper end of the conductor, d', and extending to and within loose contact with the central portion of the conductor, i, which is corrugated, an armature carried upon the central portion of the conductor, i, and means for vibrating the armature.

27. A phosphorescent illuminator consisting of the combination of an evacuated inclosure whose opposite walls are connected by substantially parallel electric conductors, f' and d', whose corresponding lower ends are connected to the terminals of an electric generator an oscillatory electric conductor i, connected to the upper end of the conductor, d', and extending to and within loose contact

with the central portion of the conductor, *i*, which is corrugated and means for vibrating the conductors *i* and *f'*, to and from each other.

28. A system of phosphorescent illumination consisting of a combination of an evacuated bulb, a tube communicating therewith and extending to distant points, means located therein for producing interruptions of an electric current passing therethrough and means for automatically maintaining the vacuum at or about a predetermined degree.

29. The combination with an evacuated inclosure of a second inclosure extending therefrom and communicating therewith and a valve between the two, one of the inclosures containing vibratory electric contacts normally in a closed circuit with one another.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 12th day of October, 1894.

D. McFARLAN MOORE.

Witnesses:
EDWARD P. THOMPSON,
ROBERT S. CHAPPELL.