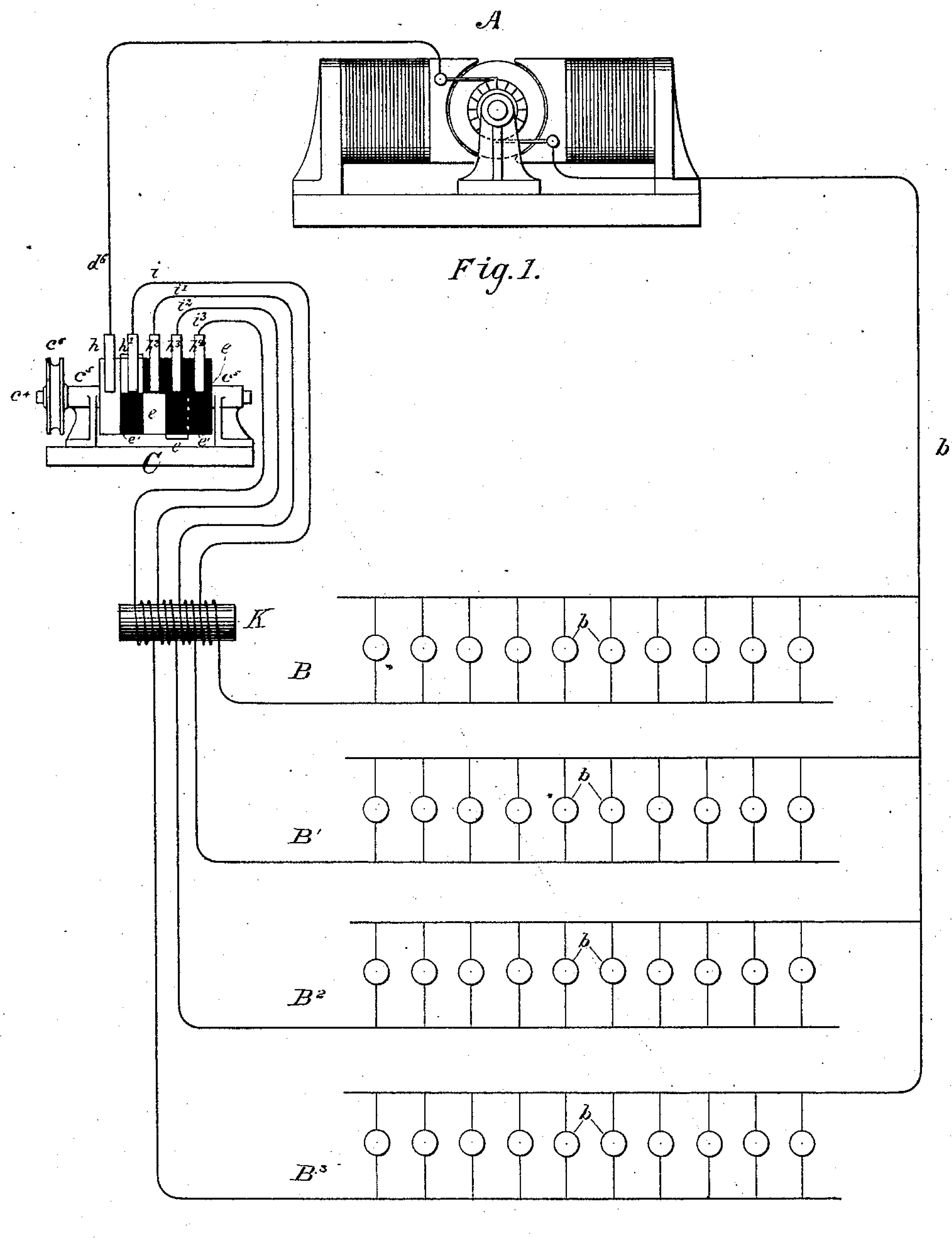
(No Model.) 2 Sheets—Sheet 1.

S. L. TRIPPE.

ELECTRIC LIGHTING SYSTEM.

No. 468,487. Patented Feb. 9, 1892.



Witnesses
Raymond F. Barnes.
Geo. Smallwood.

Inventor
Sylvanus L. Trippe
By his Attorney
Wm. H. Appleton.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

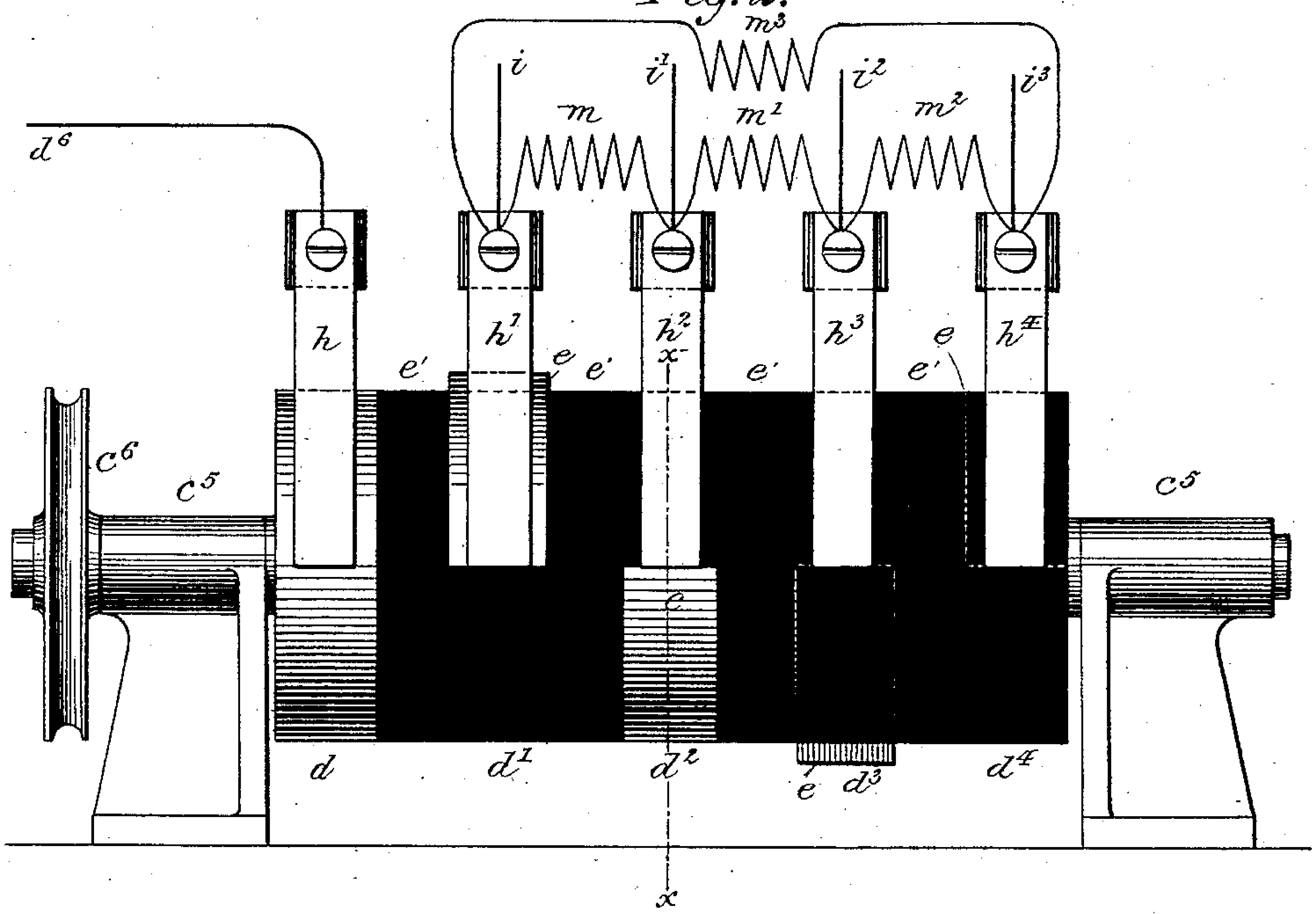
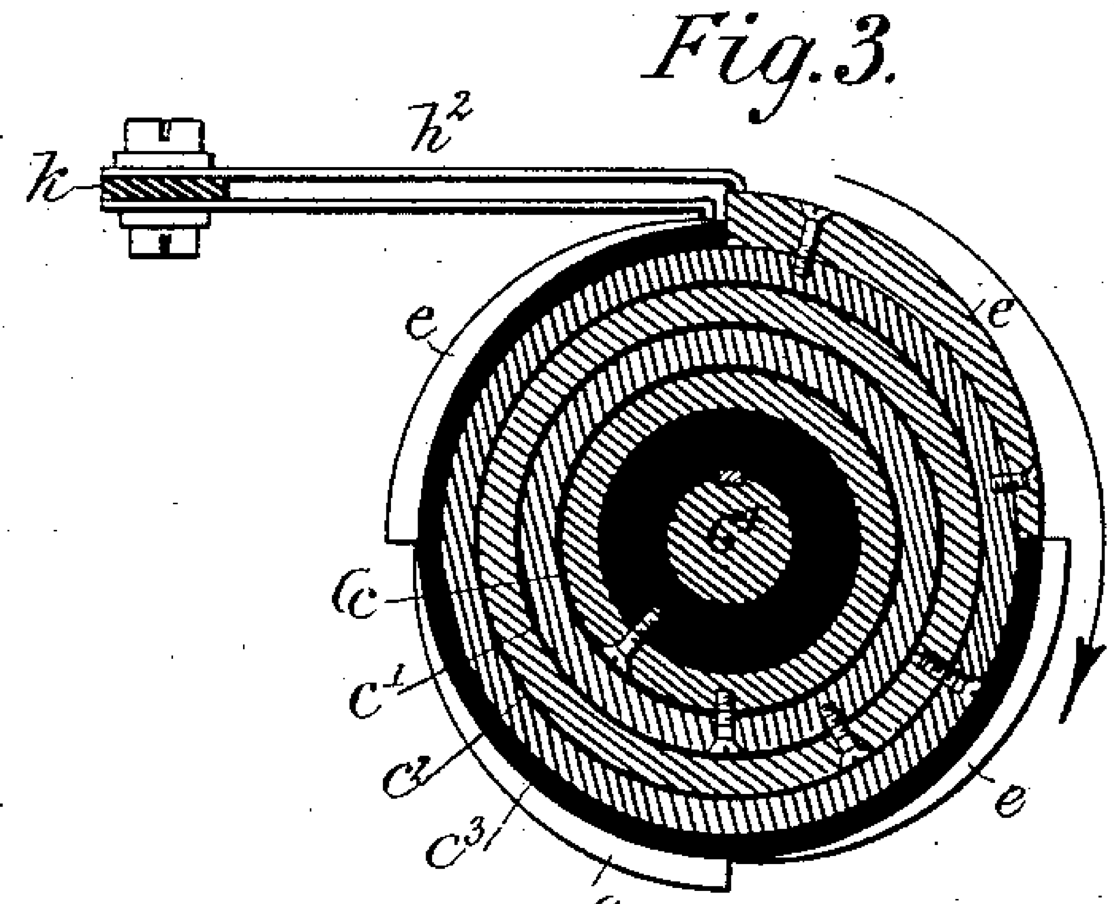


Fig. 3.



Witnesses
Raymond F. Barnes.
Geo. Smallwood.

Inventor
Sylvanus L. Trippe
By his Attorney [illegible]

UNITED STATES PATENT OFFICE.

SYLVANUS L. TRIPPE, OF NEW YORK, N. Y.

ELECTRIC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 468,487, dated February 9, 1892.

Application filed February 25, 1891. Serial No. 382,707. (No model.)

To all whom it may concern:

Be it known that I, SYLVANUS L. TRIPPE, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Electric Lighting, of which the following is a specification.

Heretofore what are known as "incandescent electric lights" have been produced by means of either a continuous, direct, or derived secondary alternating current, requiring about fifty-five watts of energy for the proper maintenance of each incandescent lamp having sixteen-candle power of illumination. In all the processes having in view a transfer of energy from one to two or more circuits alternately experiment has developed the following among other objections, which has so far prevented any such process from being of commercial value. In the first place, the break in the current necessary to the transfer from one circuit to another has, in the use of the powerful currents required in electric lighting, caused the formation of an arc or sparking at the break to such an extent that the brushes or contacts are rapidly destroyed and the switch so burned and fused as to become almost at once unfit for use. The making and breaking of contact in a current is accomplished with a drop or diminution of the electro-motive force in the supply-current, which in every instance with all appliances of which I have any knowledge is a total loss of so much of the energy employed. These objections, with others, and a failure to provide any combination of the necessary elements to carry into practice the theory of transferring energy to two or more working circuits alternately, have so far prevented any practical application of such principle.

In the use of the ordinary incandescent lamp in what is known as the "alternating system," it is evident that there is a period, however short in duration, at each alternation when no current is passing through the lamp. Hence it follows that in order to produce the light it is not necessary the current should be absolutely a continuous one. I have found by experiment and test that the period when no current passes through the lamp may be extended much beyond what is usual in the alternating systems without diminishing the light, as it is the incandescence of the carbon filament which gives the light, and such carbon requires time to cool when once heated to incandescence. The period when the current is not passing through the lamps on one circuit may be utilized by diverting the current to one or more separate circuits and made to produce like effects, thus multiplying the number of lamps now actuated on one circuit only, without any very material increase of energy from the dynamo or engine. As has been stated above, the making and breaking of contact in a circuit produces a drop or fall in electro-motive force and causes two practical difficulties necessary to be overcome before this process can be satisfactorily applied. If lamps are used of the voltage of the original supply-current, the light is not satisfactory on account of the change in the electro-motive force, and if the lamps of the lower voltage are used the current is not of sufficient volume to supply the lamps. It is therefore necessary to arrange means to utilize the induced currents in the working circuits and to increase the same by an electro-magnet in the working circuits, transforming at the same time the supply-current by means of a switch and transformer to a current of lower electro-motive force and greater number of ampères.

The object of my invention therefore is to provide means whereby not only a continuous current of electric energy may be diverted from one to two or more circuits alternately, having such current supplemented at each break thereof by an induced current flowing in the same direction through the lamp or working circuits, but the sparking and development of heat prevented on the switch and contact points.

To this end my invention consists, first, in the combination, with a dynamo-electric machine or other source of constant electric supply and a series of electric circuits for the supply of lamps, of a switch and transformer located between such dynamo or other source of energy and the working circuits, and an electric magnet interposed between such switch and transformer and the lamps; second, in the peculiar construction of the switch and transformer, whereby it is self-ventilating and adapted not only to serve as a switch, but to also act as a secondary coil in connection with the electro-magnet; third, in the appliances used in preventing sparking and the development of heat at the break of current on the switch and transformer, and, fourth, in various other constructions and combination of parts, all as will hereinafter more fully appear.

Referring to the accompanying drawings, which form a part of this specification, Figure 1 is a diagrammatic view showing four circuits of incandescent lamps with a dynamo-electric machine and my invention applied in connection therewith. Fig. 2 is a side elevation of switch and transformer, showing the arrangement of brushes and connections; and Fig. 3 is a transverse section thereof, taken in the plane $x\ x$ of Fig. 2.

In all the figures like letters of reference indicate corresponding parts.

A indicates a dynamo-electric machine or other source of electric energy, which is or may be of any ordinary or preferred construction, and B, B′, B^2, and B^3 electric circuits for supplying the necessary currents to the incandescent lamps which are shown at b. In the present instance I have shown four of these circuits, although it is obvious that a greater or less number may be employed; but whatever the number they will preferably be all connected with a common return conductor b'.

C indicates the switch and transformer, by means of which the current coming from the dynamo or other source of energy is deflected from one to the other of the circuits and back again to the first in regular succession, and so on, and the current transformed from a higher to a lower tension. This switch and transformer is preferably made up of a series of copper or brass tubes or cylinders $c\ c'\ c^2\ c^3$, inclosed within each other and bolted or otherwise fastened together with a little space between the several tubes or cylinders, so as to ventilate the same when in motion. As thus constructed, it is mounted on an axis c^4, from which it is insulated, the said axis being journaled in suitable bearings c^5 and capable of rotation therein through power applied to the pulley c^6, secured thereon; or, if desired, the switch and transformer may be mounted on a prolongation of the dynamo-shaft. The outside of the switch and transformer, in the case of the one shown in the drawings, is divided into five sections $d\ d'\ d^2\ d^3\ d^4$. Section d is constructed with a continuous conducting-surface throughout and communicates any current that may be delivered to it from the source of energy to the other four sections, all of which are connected electrically thereto; but sections $d'\ d^2\ d^3\ d^4$ each have their outside surface divided into alternate conducting and non-conducting spaces or segments $e\ e'$, which are so disposed with respect to each other that the conducting-surfaces of the successive sections shall follow each other in their own planes of rotation, the rear termination of one being opposite to the forward end of the other, as shown. In the construction of these spaces or segments the non-conducting ones may be formed by planing away sufficient of the outer surface and filling in the spaces thus formed with some proper insulation, or these spaces or segments may be formed of a number of detachable pieces which are fastened to the outer cylinders by screws or bolts, as shown. The conducting-segments extend a little beyond the general circumference of the cylinder and slope gradually in the direction of the motion of the switch and transformer, but terminate at an acute angle on the other edge.

Resting upon the several sections of the switch and transformer are brushes or contact-strips h, h', h^2, h^3, and h^4, which are supported in place by a proper support similar to that in use in general dynamo-machines and placed with their free ends in line with respect to the switch and transformer. The brush h is connected through the wire d^6 with the dynamo or other source of energy, and the brushes h', h^2, h^3, and h^4 are connected with the four working or lamp circuits B, B′, B^2, and B^3 through wires $i\ i'\ i^2\ i^3$, which pass around the electro-magnet K, interposed between the lamps and the transformer C. The brush h, resting on section d of the switch and transformer, is an ordinary metallic brush or strip of copper, such as in general use for dynamo-machines; but brushes h', h^2, h^3, and h^4 are each constructed of two metal strips or separate brushes, one upon the other, and fastened together by screws or clamps, with an insulating-strip placed between the upper and lower parts thereof, as shown at k in Fig. 3. The upper parts of these brushes extend a short distance beyond the lower parts, and to each a wire may be attached. The under part of the brushes h', h^2, h^3, and h^4 are connected directly with the working or lamp circuits, as shown, and the upper part of the brushes are connected through the shunts m, m', m^2, and m^3 with the lamp or working circuit, which is next in the order of the rotation of the switch and transformer, such shunts having, preferably, a greater resistance than that of the lamp-circuits. As thus arranged, the free ends of the brushes, being in line with each other, it will be seen that as the switch and transformer is rotated and the under strip of one of the brushes breaks contact with the conducting-segment thereon the upper strip of that brush is brought into contact therewith, taking up the excess current and passing the same through the shunt to the next circuit, then closed by the lower strip of the next brush coming into contact with a conducting-segment of the switch and transformer, and continuing so to pass the current until the conducting-surface passes from under the same by the rotation of the switch and transformer, and so on. By these means, as will be seen, the closing of any one of the circuits by the rotation of the switch-transformer brings the wire of such circuit and the entire switch-transformer into that circuit, and as at the same instant that this circuit is formed the adjoining preceding circuit in the order of formation is broken, leaving that portion of such broken circuit beyond or following the switch-transformer as the only portion thereof through which the current ceases to flow, it follows that this particular portion of the broken circuit alone acts inductively on the closed circuit as a primary coil, while the latter circuit, with the entire switch-transformer, acts as a secondary coil. The average surface or cross-section of this closed circuit, with the included switch-transformer, being greater than that of the broken circuit, the current induced therein will necessarily be of greater volume and of less electro-motive force than that of the primary current; but flowing in the same direction as the supply-current it unites therewith in supplying the lamps, and thus, through the operation of the switch-transformer, the supply-current is not only transformed from a higher to a lower electro-motive force, but also to one of greater volume.

The electro-magnet may be made of a number of metal strips properly bound together in the usual well-known manner and needs no specific description herein.

As thus constructed, the operation of the mechanism is as follows: The current proceeding from the dynamo or other source of energy is supplied to section d of the rotating switch, and thence passes to the remaining sections d', d^2, d^3, and d^4, with which the section d is electrically connected. The current being thus continuously supplied to the several sections and the switch rotated, the conducting-segment e on the section d' will be first brought into contact with its brush h', closing the circuit B and allowing the current to flow through the lamps b of that circuit and thence back along the return-conductor b' to the source of supply. The circuit thus formed will permit of the current flowing therethrough until, in the rotation of the switch, the conducting-segment e on the section d' passes from under its brush, when the brush h^2 will engage with the conducting-segment e of the section d^2, and the circuit B' will be similarly formed. The several brushes h', h^2, h^3, and h^4 being made up of an upper and an under metal plate insulated from each other, with the upper plate projecting beyond the under, the segment e' on the section d' will first pass out of engagement with the under of such plates. At the instant the conducting-segment e of section d' passes from contact with the under plate of the brush h' the conducting-segment e of section d^2 engages with the under plate of brush h^2, and thereby transfers the current to and forms the circuit B', breaking at the same time the circuit B. The upper plate of brush h', projecting beyond the under plate of such brush, as before explained, remains in contact with the conducting-segment e of the section d' after the under plate has broken contact therewith, and serves to take up the excess current, which would otherwise form a spark, and convey the same through the resistance m to the next circuit in the order of rotation. The circuit B', having been formed by the engagement of the conducting-segment e of the section d^2 with the under plate of brush h^2, continues until such segment passes from under said plate, when the under plate or brush h^3 will come in contact with the conducting-segment e of section d^3, and so on, the passing of the conducting-segments from and into contact with the under plates of the several brushes serving to successively break and make the circuits in which they are respectively located, and the upper plates, through their resistance-shunts, serving to take up the excess of current as the circuits are broken and pass it to the next circuit in the order of rotation. The currents flowing from the several brushes thence pass around the electro-magnet and thence to the lamps, the effect of which is to augment the several currents induced by the successive breaking of the circuits as the switch is rotated.

In the practical application of this process, while the break in the metallic contact between the brush on one circuit and the actual contact of the brush with the conducting-segment of the adjoining circuit is mechanically made as near as possible at the same instant, the current will begin to flow in the closing-circuit a period of short duration before the current is broken in the other, which last current forms an arc, as shown by the sparking developed at the break of metallic contact. As it is the actual make or break in the current which causes the formation of an induced current in an adjoining circuit, a period, however short, exists between the break in the metallic contact and the break in the current itself when the induced current is developed, and, if any induced current should be caused in the contrary direction by making the metallic contact in the circuit being closed, such current would act in opposition to and tend to diminish the flow of the primary current in said circuit. The upper part of the brush being connected by a shunt to the working circuit through a resistance greater than that of the circuit, the current will naturally pass through the path of least resistance and will cease to flow through the upper part of the brush before it leaves contact with the conducting-segment, thereby preventing any sparking by the break in the current in any of the circuits when the same is broken or transferred to the adjoining circuit, as incandescent lamps of proper volume will only take the voltage required.

The object of interposing an electro-magnet, around which the wires leading to the lamp-circuits are passed, is to increase the effects of induction in the various circuits. While it may not be absolutely necessary to the working of this system, it is found by experimental tests that in many cases it will prove of much advantage, especially where a small volume of high voltage is desired to be transformed into current of much less voltage and of greater ampères.

The construction of the switch and transformer from a series of tubes or cylinders inclosed one within another necessarily forms a reservoir for energy, which, acting as a stored supply, will modify the effect of any irregularity in the supply-current and tend to regulate and make steady the light in the lamps when, as in practical working lamps, any may be turned on or off and the number varied in the different working circuits.

To the successful working of this system there must be a transfer of energy from one to two or more circuits alternately, a transformation of the current from a higher to a lower electro-motive force of greater volume, a union of the currents of induction with the main supply-current, adequate means for preventing the brushes and switch and transformer from destruction by the heat developed thereon by sparking or the forming of an arc at the break in the current, and an adaptation of the resistance in the lamp-circuits to the current as modified by its transfer through the mechanism. All of these features must be so adjusted as to work in harmony, which is readily effected by the necessary change in the surface of the switch and transformer and by increasing and diminishing the speed of its rotation as the degree of transformation in the supply-current may require, while the construction of the switch and transformer form a series of tubes or cylinders with air-spaces between for ventilation, and the method described for preventing sparking at the break in the current prevents the development of heat and enables the mechanism to be operated without the destruction of contacts and switch and transformer provided with such protection.

Although in the foregoing I have shown and described the transformer as employing a cylinder upon which the electric conducting and non-conducting segments are mounted, it is obvious that, instead of employing such cylinder, I may make use of a disk upon the face of which the said segments may be formed or secured, the disk in this instance being preferably made up from a series of rings arranged the one within the other with a space between them for ventilation, as is the case with the cylinder when employed.

I am aware that apparatus has been devised for transferring an electric current from one to two or more circuits alternately, and also for transforming a current from a high to a low electro-motive force of greater volume. This I do not claim, broadly; but,

Having described my invention and one way in which it is or may be carried into effect, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination, with an electric generator and a series of two or more circuits, of a switch and transformer and an electro-magnet both interposed between the generator and the circuits, substantially as described.

2. The combination, with a dynamo-electric machine or other source of electric energy and a plurality of circuits, of a switch and tranformer for deflecting the current from one circuit to another and an electro-magnet for co-operation therewith, substantially as described.

3. A cylinder composed of a series of metal tubes arranged the one within the other and secured together, with its surface provided with electric conducting and non-conducting segments, substantially as described.

4. A cylinder composed of a series of electric conducting metal tubes arranged the one within the other and secured together, with its surface provided with a plurality of series of electric conducting and non-conducting segments arranged side by side, the conducting-segments of one series being placed behind the conducting-segments of the other or others, whereby to follow them in their own plane or planes of rotation, and an axis upon which the cylinder is mounted and rotated, substantially as described.

5. A cylinder composed of a series of electric conducting metal tubes arranged the one within the other and secured together with spaces between them, the surface of said cylinder being provided with a plurality of series of electric conducting and non-conducting segments arranged side by side along the cylinder, with the conducting-segments of one series placed behind the conducting-segments of the other or others, whereby to follow them in their own plane or planes of rotation, and an axis upon which the cylinder is mounted and rotated, substantially as described.

6. A cylinder composed of a series of electric conducting metal tubes arranged and secured the one within the other, with a plurality of series of electric conducting and non-conducting segments arranged upon its surface side by side along the same, the conducting-segments being constructed with a gradually-enlarging or eccentric portion and an abrupt rear termination, and the said conducting-segments of one series being placed behind the conducting-segments of the other or others, whereby to follow them in their own plane or planes of rotation, substantially as described.

7. The combination, with a rotating cylinder having a plurality of series of electric conducting and non-conducting segments arranged upon its surface side by side, whereby the conducting-segments of one series follow the conducting-segments of the other or others in their own plane or planes of rotation, of a

series of contact pieces or brushes composed of an upper and an under part insulated from each other for co-operating with said segments, the upper parts of the contact pieces or brushes extending slightly beyond the under parts and being connected by resistance-shunts to the next circuits in order, respectively, substantially as described.

8. The combination, with a rotating cylinder having a plurality of series of electric conducting-segments arranged upon its surface in such order that the conducting-segments of one series follow the conducting-segments of the other or others in their own plane or planes of rotation, and a series of circuits, of a series of contact pieces or brushes composed of an upper and an under part insulated from each other for co-operating with said segments, the under part of the several contact pieces or brushes being connected to their appropriate circuit and the upper part of said pieces or brushes extending slightly beyond the under part and connected by a resistance-shunt to the next circuit in order, substantially as described.

SYLVANUS L. TRIPPE.

Witnesses:
M. D. GARDNER,
WILLIE RATHKE.