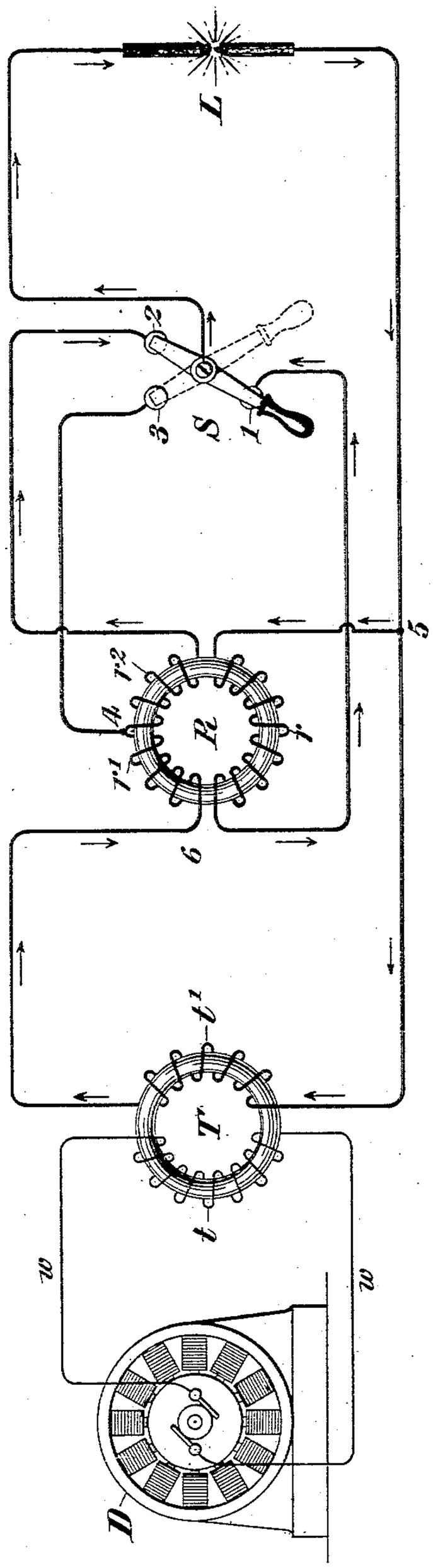
(No Model.)

T. SPENCER.

ELECTRIC ARC LIGHTING SYSTEM.

No. 504,632. Patented Sept. 5, 1893.



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THOMAS SPENCER, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRIC-ARC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 504,632, dated September 5, 1893.

Application filed February 18, 1893. Serial No. 462,828. (No model.)

To all whom it may concern:

Be it known that I, THOMAS SPENCER, a citizen of the United States, residing in the city and county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Methods of and Apparatus for Electric-Arc Lighting, of which the following is a specification.

My invention relates to a method of supplying an electric current to an arc lamp, which current shall be of the necessary potential and volume to give the maximum amount of light with the least expenditure of energy, notwithstanding that such energy may be derived from a system of main conductors charged with a current of higher potential and of less volume than that which is most advantageously used in the lamp, and it also embraces certain methods and apparatus whereby the lighting of the lamp in the first instance is more certainly and conveniently effected.

My said improvements are more especially intended to be used in connection with arc-lamps which are operated by alternating currents of electricity.

The accompanying drawing is a diagram of an apparatus embodying my invention.

In the drawing, D is a dynamo-electric machine, here shown as of the alternate current type; which is connected by conductors *w w* with the primary winding *t* of a transformer T of the usual well-known construction. The secondary winding *t'* of this transformer supplies an alternating current to a second transformer R provided with three windings *r r'* and r^2, which surround a preferably endless iron core in a manner well understood. The windings *r'* and r^2 are in fact one continuous coil wound in the same direction, and are independent of the winding *r*.

At the point 4, at the junction of the windings *r'* and r^2, a conductor is attached which extends to the switch-point 3. The opposite terminal of the winding r^2 is connected in like manner to the switch-point 2. One of the electrodes of the arc-lamp L is connected to the lever S of the switch, and the other electrode of the lamp is connected directly through the point 5 with one terminal of the winding *t'* of the transformer T, the other terminal of which is connected at the point 6 to the remaining terminal of the winding *r'* of the second transformer R. Finally the remaining winding *r* of the transformer R has one of its terminals connected directly with the lamp L by way of point 5, while its remaining terminal goes to the switch-point 1.

The switch-lever S is capable of being placed in three different positions. When in the position shown in dotted lines in the figure, the lamp L is connected through the point 3 with the winding *r'*, and both the windings *r* and r^2 are disconnected from the circuit; when in the position shown in full lines, which is that corresponding to the normal operation of the lamp, all three windings of the transformer R are in circuit; and when in a third position the conductor attached to the lamp L may be left open at S so as to entirely disconnect the lamp from the circuit. If now, a current of a definite potential be established in the circuit *w w* by the action of the generator D, the switch S being in the position indicated by the dotted lines, the current generated in the secondary winding *t'* of the transformer T will pass through the winding *r'* and thence by way of the points 4 and 3 to the lamp L, thence returning to the other terminal of the winding *t'*. By reason of the presence of the winding *r'* with its iron core in the circuit, a certain counter-electromotive force will be set up, which will act in the same manner as a rheostat would, to reduce the potential of the current traversing the lamp. Therefore the current traversing the lamp is that due to the difference between the direct electromotive force due to the winding *t'* and the counter-electromotive force due to the winding *r'*, and these are so proportioned that the resulting current has sufficient potential to light the lamp with promptness and certainty, and establish its operation immediately upon the closing of the circuit by the switch S upon the point 3. I have however found that after the lamp has been lighted and its arc established, a much less difference of potential is required to maintain it in continuous and satisfactory operation, than is required to light it, and that the use of the lesser potential greatly conduces to economy of operation. After the

lamp L has been lighted, therefore, the switch S is changed to the position shown in the full lines. The lamp will now be operated by a composite current, due to the impressed electromotive force generated in the winding t' of the transformer T, less the counter-electromotive force set up in the second transformer R, as hereinafter explained. If for example, it be assumed that the transformer T is supplying a potential difference of one hundred volts between the terminals of the sum of the windings upon the transformer R, that is to say, between the points 5 and 6 then the difference of potential or voltage of the current acting in the lamp would be less than one hundred volts depending upon the number of turns cut in on the primary coil of transformer R. Any required potential less than that of the original impressed potential may thus be produced in the lamp circuit, by establishing a proper relation between the number of convolutions of the respective primary and secondary coils upon the transformer R. The point of connection 4 will preferably be made at such a point that the section r' of the coil which is in circuit when the switch bears on contact 3 will cause the desired voltage to start the lamp into operation. Evidently this may be fixed at any desired value less than the voltage supplied at the transformer R by the winding t' of transformer T by varying the number of convolutions between the point of connection and the point of entry 6 into the section r'. When, however, the switch S is thrown upon contact 2, both sections r' and r^2 of the primary coil will be in series relation and a greater drop in the voltage will result, but in this position of the switch it will be noted that the secondary coil r is closed upon the arc through the switch so that it joins in multiple arc with the primary coil in supplying the lamp. The current furnished by the secondary r may, of course, be adjusted as to voltage and ampèrage by a proper proportioning of the convolutions and cross-section of the winding.

I claim as my invention—

1. The hereinbefore described method of lighting an electric arc-lamp, which consists in the initial application thereto of a current having a potential in excess of the potential of the ordinary working current of the lamp.

2. The hereinbefore described method of lighting an electric arc-lamp, which consists in the initial application thereto of an alternating current having a potential in excess of the potential of the ordinary working current of the lamp.

3. The hereinbefore described method of lighting an electric arc-lamp, which consists in temporarily withdrawing from the lamp-circuit a portion of the resistance encountered by the current during the normal operation of the lamp, in order to increase the potential between the lamp terminals at the moment of lighting.

4. The hereinbefore described method of lighting an electric arc-lamp, which consists in temporarily diminishing the counter-electromotive force in the lamp circuit and thus creating an excess of potential between the lamp terminals at the moment of lighting.

5. The hereinbefore described method of lighting an electric arc-lamp, which consists in temporarily decreasing the length of that portion of the lamp circuit which is under the opposing inductive influence of the iron core of the transformer, whereby an excess of potential is created between the terminals of the lamp at the moment of lighting.

6. The combination with an electric arc-lamp, of a transformer having its secondary winding in two sections, and a switch whereby said lamp may be included in circuit either with one or with both of said sections, as and for the purpose set forth.

7. The combination with an electric arc-lamp, of a transformer having a primary winding and a secondary winding made in two sections, and a switch whereby said lamp may be included in circuit with the primary and with both sections of the secondary windings, or may be detached from said primary and one of said secondary windings, as and for the purpose set forth.

8. The combination with an electric arc-lamp of a transformer having a primary winding and a secondary winding made in two sections, and a three-point switch whereby said lamp be included in circuit with the primary and with both sections of the secondary windings, or detached from said primary and from one of said secondary windings, or detached from all of said windings, as and for the purpose set forth.

In testimony whereof I have hereunto subscribed my name this 6th day of February, A. D. 1893.

THOMAS SPENCER.

Witnesses:
JOHN MUSTARD,
A. H. MUSTARD.