No. 677,605, Patented July 2, 1901.

T. SPENCER.

ELECTRIC ARC LAMP.

(Application filed Feb. 19, 1901.)

(No Model.)

FIG. 1.

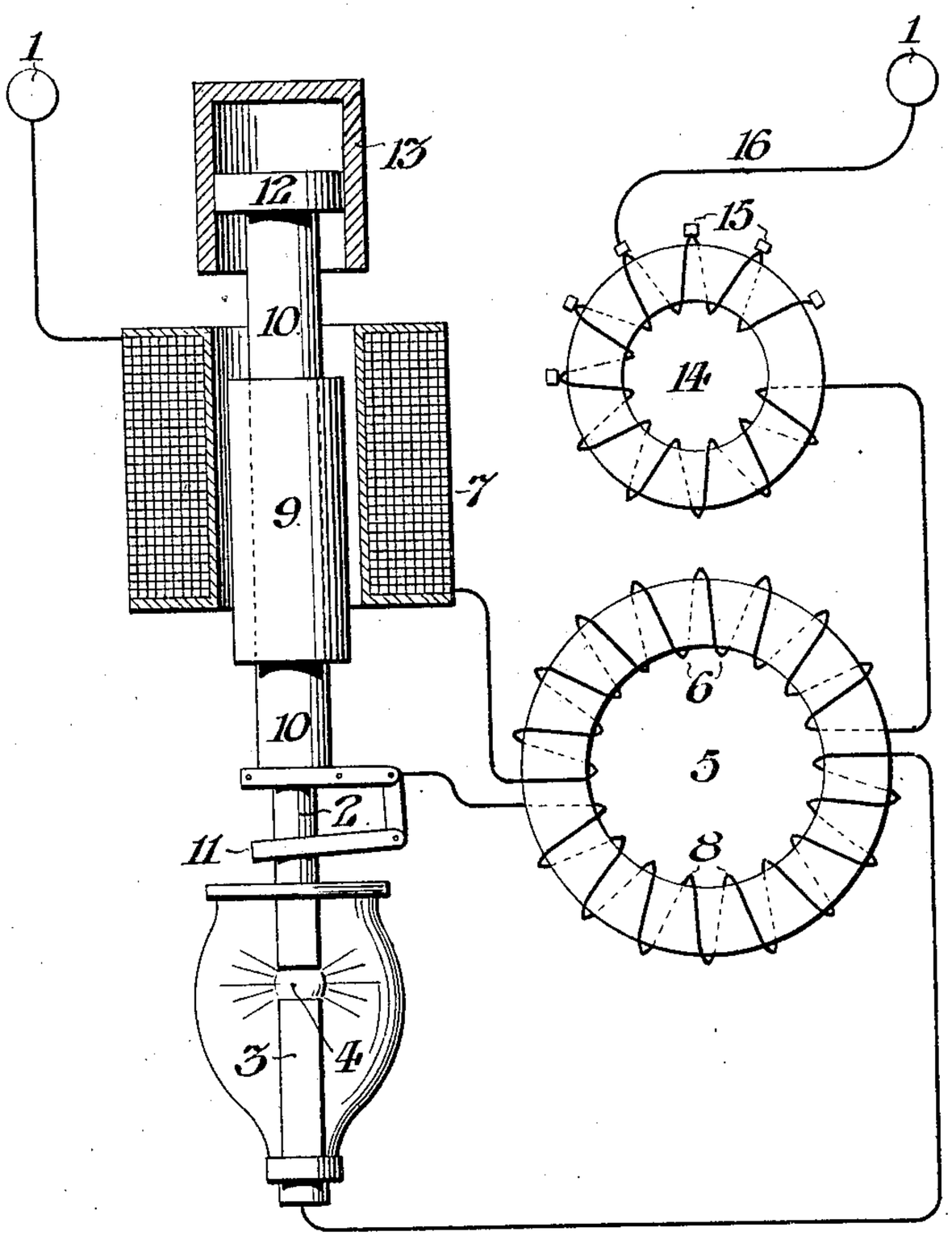
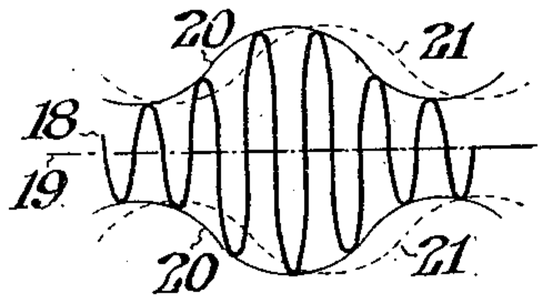


FIG. 2.



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UNITED STATES PATENT OFFICE.

THOMAS SPENCER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO HELIOS-UPTON COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 677,605, dated July 2, 1901.

Application filed February 19, 1901. Serial No. 47,937. (No model.)

To all whom it may concern:

Be it known that I, THOMAS SPENCER, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Electric-Arc Lamps, whereof the following is a specification, reference being had to the accompanying drawings.

This invention relates particularly to electric-arc lamps adapted for operation in an alternating-current circuit, and my improvements are of special advantage in their application to lamps of the inclosed-arc type.

It is the object of my invention to provide means to regulate an arc with greater accuracy than has been hitherto attainable in an alternating-arc lamp and in view of the increased stability of the arc to permit such a lamp to be operated with a higher voltage at the arc than has been hitherto possible in a circuit of given voltage, thus reducing the shadow of the carbons and thereby increasing the available amount of light produced.

My invention consists in the employment of a transformer whose primary coil is in series circuit with the regulating-coil of the lamp and whose secondary coil is in series circuit with the lamp-arc, whereby the arc is supplied with the current induced in the secondary coil of said transformer, and the compensating adjustment of the length of the arc is effected by the current through said primary coil before the fluctuations in the induced current in said secondary coil can be manifested at the arc, so that each fluctuation in the current is neutralized and the arc remains stable.

It is well known that an arc cannot be burned in direct connection with a constant-potential circuit for the reason that the resistance of the arc decreases with any increase of current and increases with any decrease of current, producing violent fluctuations of the arc. As the resistance at the arc may be increased by lengthening the arc it would seem theoretically possible to compensate for variations in the current by variations in the distance of separation of the carbons. However, as the force to separate the carbons is derived from the current and the considerable inertia of the regulating mechanism must be overcome before any movement thereof can be effected the compensating adjustment of the length of the arc, initiated by a given fluctuation in the current, is always so much delayed that the fluctuation is manifested at the arc in advance of the adjustment. Therefore the regulating mechanism aforesaid is usually supplemented by a choking-coil or by a dead resistance, both of these devices having characteristics opposite to that of the arc, to wit: The drop of electrical potential across them increases when the current increases and decreases when the current decreases.

Although the ordinary method of regulation aforesaid produces stability in the arc, it requires so much self-induction or resistance that it is impossible to operate a lamp with that length of arc which will give the greatest amount of light per unit of energy consumed.

In the accompanying drawings, Figure 1 shows a convenient embodiment of my invention, and Fig. 2 is a diagram illustrating the peculiar variations in the current which it is the object of this invention to compensate.

Referring to Fig. 1, 1 1 are the terminals of the lamp-circuit, which includes the movable carbon 2 and the stationary carbon 3, between which the arc 4 is formed. The transformer 5 comprises the primary coil 6, in series circuit with the regulating-coil 7, and the secondary coil 8, in series circuit with the arc 4. Said regulating-coil 7 is arranged to operate on the plunger 9, attached to the carbon-holder 10, which latter carries at its lower extremity the ring-clutch 11 for the carbon 2 and is provided at its upper extremity with the head 12, which coöperates with the cylinder 13 to form a dash-pot serving to check the movement of said plunger 9.

The choking-coil 14 is in series circuit with the primary coil 6 of the transformer and is conveniently provided with a series of terminals 15, so that the effective resistance of the coil may be adjustably varied by the connection of the flexible conductor 16 with any one of said terminals.

The operation of my device above described being based upon the fact that any fluctuation in the current in the primary coil of a transformer is always in advance of the corresponding fluctuation in the induced current

in the secondary coil of the transformer, the peculiar operation of my invention may be understood by reference to the conventional diagram, Fig. 2, wherein the waves in the line 18, rising above and falling below the zero-line 19, respectively, indicate the momentary maximum potential of the current at each alternation thereof. In such a representation of a uniform current the waves in the line 18 would be of equal amplitude, and the difference in amplitude of the waves (shown in Fig. 2) indicates the fluctuations in the current which it is the object of my invention to compensate. The full lines 20, touching the crests of the waves in the line 18, indicate the phases in a current fluctuation in the primary coil 6 of the transformer 5, and the dotted lines 21 indicate the phases of the corresponding fluctuation in the current induced in the secondary coil 8 of the transformer 5, which latter fluctuation induced in the arc-circuit lags so far behind the initial fluctuation in the primary regulating-circuit as to permit the regulating-coil 7 to overcome the inertia of the regulating mechanism and make the necessary adjustment of the length of the arc before the delayed fluctuation in the secondary circuit can be manifested at the arc. Therefore the length of the arc in my improved lamp being automatically varied in precise accordance with each fluctuation of the current supplied thereto and in such sequence that the stability of the arc is constantly maintained, the lamp may be operated with a voltage at the arc very nearly equal to that of the supply-circuit, with all of the advantages of efficiency and economy incident to such a condition of operation.

I do not desire to limit myself to the precise construction or arrangement of my improvements herein set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention.

I claim—

1. The combination with an electric-arc lamp; of a transformer whose primary coil is in series circuit with the regulating-coil of the lamp, and whose secondary coil is in series circuit with the lamp-arc; whereby compensating adjustment of the length of the arc is effected by a fluctuation of the current through the primary coil of the transformer before the corresponding fluctuation in the current induced in the secondary coil is manifested at the arc.

2. The combination with an electric-arc lamp; of a transformer whose primary coil is in series circuit with the regulating-coil of the lamp, and whose secondary coil is in series circuit with the lamp-arc; and a self-induction in series with the primary coil of said transformer and said regulating-coil; whereby compensating adjustment of the length of the arc is effected by a fluctuation of the current through the primary coil of the transformer before the corresponding fluctuation in the current induced in the secondary coil is manifested at the arc.

3. The combination with an electric-arc lamp; of a transformer whose primary coil is in series circuit with the regulating-coil of the lamp, and whose secondary coil is in series circuit with the lamp-arc; a choking-coil in series with the primary coil of said transformer and said regulating-coil; and means to adjustably vary the effective self-induction of said choking-coil; whereby compensating adjustment of the length of the arc is effected by a fluctuation of the current through the primary coil of the transformer before the corresponding fluctuation in the current induced in the secondary coil is manifested at the arc.

4. In an electric-arc lamp comprising opposed carbons, the combination with a regulating-coil arranged to separate said carbons; of the primary coil of a transformer in series circuit with said regulating-coil; and the secondary coil of said transformer in series circuit with the arc between said carbons, substantially as set forth.

5. In an electric-arc lamp comprising opposed carbons, the combination with a plunger operative to separate said carbons; of a regulating-coil arranged to actuate said plunger; the primary coil of a transformer in series circuit with said regulating-coil; and the secondary coil of said transformer in series circuit with the arc between said carbons, substantially as set forth.

6. In an electric-arc lamp comprising opposed carbons, the combination with a plunger operative to separate said carbons; of a regulating-coil arranged to actuate said plunger; the primary coil of a transformer in series circuit with said regulating-coil; the secondary coil of said transformer in series circuit with the arc between said carbons; and a variable resistance in series circuit with said regulating-coil, substantially as set forth.

In testimony whereof I have hereunto signed my name, at Philadelphia, Pennsylvania, this 11th day of February, 1901.

THOMAS SPENCER.

Witnesses:
FRANK S. MARR,
HARRY HUSKEY.