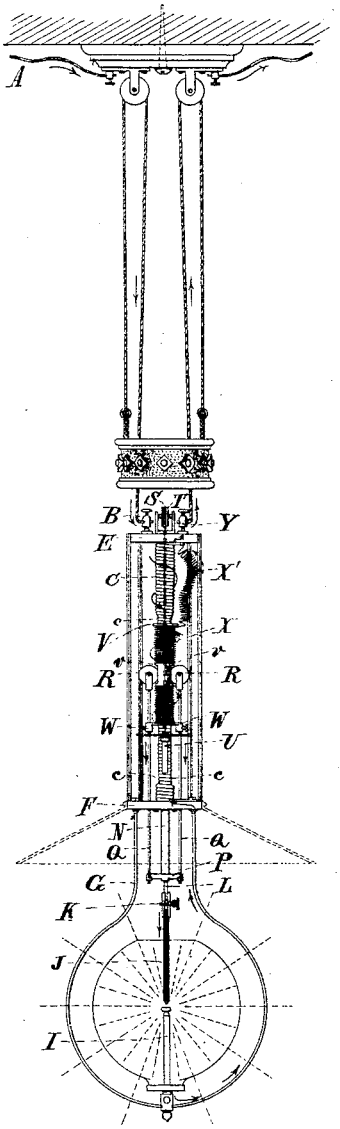
(No Model.) 3 Sheets—Sheet 1.

W. M. THOMAS.

ELECTRIC ARC LAMP.

No. 263,246. Patented Aug. 22, 1882.

Fig. 1.



Attest
Carl Spengel
Harry Eknight

Inventor
William M. Thomas
by Knight Bros.
Attys.

(No Model.) 3 Sheets—Sheet 2.

W. M. THOMAS.

ELECTRIC ARC LAMP.

No. 263,246. Patented Aug. 22, 1882.

Fig. 2.

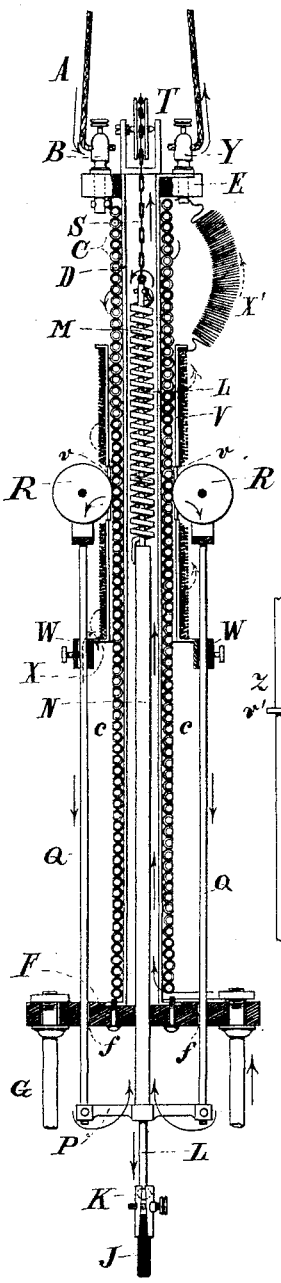


Fig. 3.

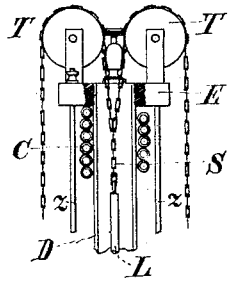


Fig. 5.

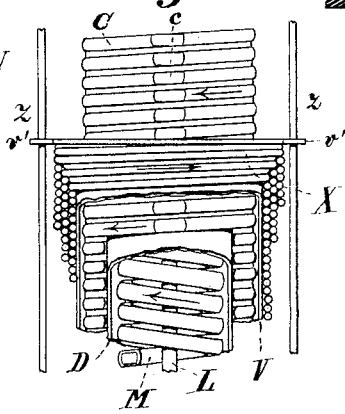
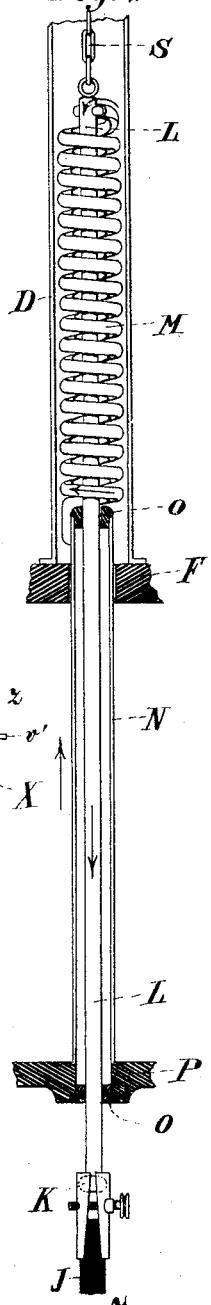


Fig. 4.



Witnesses
Carl Spencer.
Harry E. Knight

Inventor
William M. Thomas
By Knight Bros Atty's.

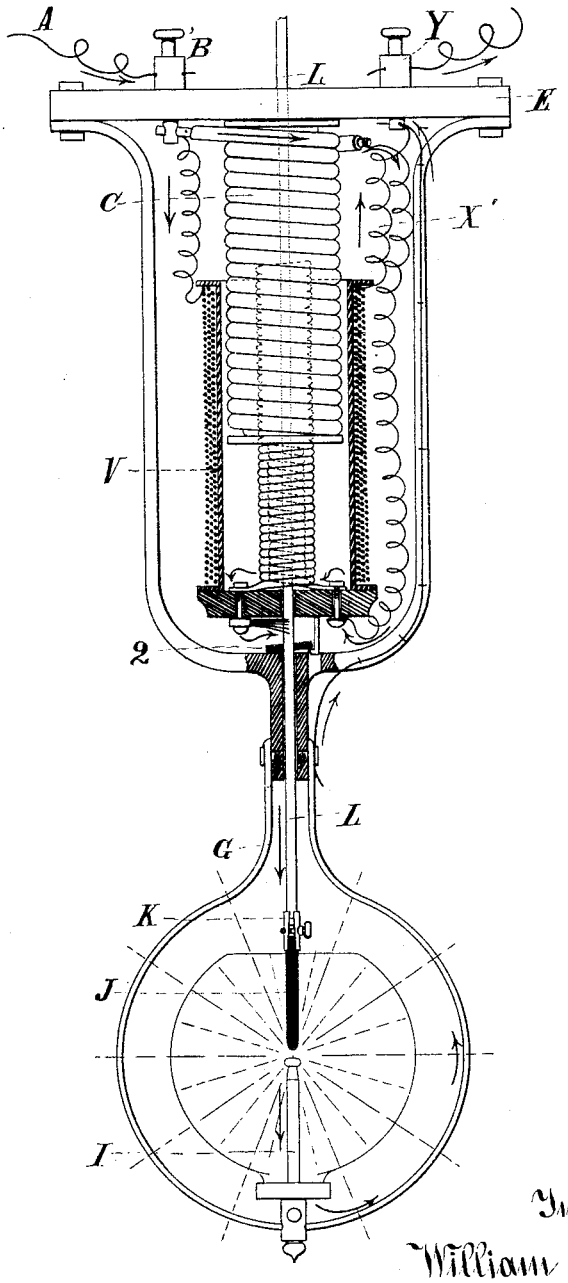
(No Model.) 3 Sheets—Sheet 3.

W. M. THOMAS.

ELECTRIC ARC LAMP.

No. 263,246. Patented Aug. 22, 1882.

Fig. 6.



Attest:
Carl Spengel
Harry C. Knight

Inventor
William M. Thomas
By Knight Bros Atty's.

UNITED STATES PATENT OFFICE.

WILLIAM M. THOMAS, OF CINCINNATI, OHIO, ASSIGNOR OF ONE-HALF TO SAMUEL W. SKINNER, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 263,246, dated August 22, 1882.

Application filed June 29, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. THOMAS, of Cincinnati, Hamilton county, Ohio, have invented new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention relates to improvements on those arc electric lamps employed "in series," the automatic equalization of whose arc intervals is maintained by the magnetic interaction of helices, which constitute portions of the channels through which the electric current passes. The necessity and the mode of operation of such equalizing instrumentalities, partially explained in an application for patent filed by me 29th day of April, 1882, may be more succinctly expressed as follows:

It is well known that no two arc electric lamps in any given series behave precisely alike. In one lamp the magnetic lift incident to increased current flow takes place more promptly and with greater facility, with a consequently greater arc interval, than in the others. Such disproportionate increase of arc interval in one lamp necessarily weakens the current throughout the series, and thus detracts from the lifting-power of all, but most so from those of the most sluggish movement. The heavier-working lamps, thus dwindling in illuminative action, cease one by one to respond to the continually-waning magnetic energy. In strong contrast with and at the expense of this enfeebled action of the weaker lamps, the arc of the most susceptible or easiest-working lamp continues to expand until it practically monopolizes the effective activity of the entire circuit. The remedy for such unequal action lies in a provision whereby, when the arc-resistance of any given lamp becomes higher than normal the current is automatically diverted from the arc of that lamp to the next lamp of the series, or to "line" or generator, as the case may be, to sufficiently reduce or counteract the "helix suction" of the lamp thus regulated to restore its arc interval to normal length, and at the same time, by diminution of its arc-resistance, to secure resumption of normal current flow throughout the series.

In my present invention illuminative equilibrium throughout a given series of arc electric lamps is secured by the respective current repulsion from and attraction toward the prime helix of two helical current-carriers attached to the same frame which holds and feeds the positive electrode, and which play one within and the other outside of the prime helix and concentric with the same. The locations of the two moving helices, respectively inside and outside of the prime helix, are interchangeable, and the electrode-current may or may not be taken by sliding conductors from bared tracks upon the prime helix, such as described in my Patent No. 253,322, granted 7th February, 1882. I however prefer and here describe such mode of conduction, and I also prefer and describe the lifting-helix, known in this specification as the "solenoid," arranged within, and the depressing helix, known in this specification as the "differential," arranged outside, of the prime helix.

With these objects in view my lifting member is, as the name I have given it implies, of solenoid form, and consists of a helix of insulated wire of same grade as that of the prime helix. This solenoid, which plays up and down inside of, without touching, the prime helix, the current from the prime helix is compelled to traverse on its way to the electrode, the convolutions being so arranged as for the solenoid-current to flow in the same direction as the neighboring current of the prime helix, so as to set up an attraction between the solenoid and prime helix.

My depressing or differential helix composes a portion of an overflow-wire, whose resistance is such as to render it comparatively inert during normal action, and which is wound upon a non-magnetic bobbin that, in common with the solenoid, is attached to and travels with the positive-electrode holder. This bobbin surrounds without touching the prime helix, and its enveloping wire is so wound as, when carrying off overflow, to conduct the current in the reverse direction to that of the neighboring portion of the prime helix. This overflow-current carrier has electrical connection by its lower end with the positive electrode, and by its upper end with line beyond the negative electrode, so as, whenever called into ac-

tion, to "shunt" or "short-circuit" the arc. In this arrangement of parts the mechanical potency (lift) of the solenoid is, during normal activity of the lamp, counteracted to a greater or less extent, commensurate with the overflow, by the opposing downward pull of the excited differential. As above intimated, these movements operate in a twofold capacity—namely, by reducing to normal length the arc of the individual lamp and by such reduction of the resistance of that arc as to permit the passage of adequate current to the weaker lamps, resulting in uniform arc intervals and equal illuminative action throughout the series.

The above-described arrangement, it will be seen, secures both normal regulation of the individual lamp and differential regulation relatively to others of the series by the attractive and repellent energies of simple helices or current-carriers without the use of a ferro-magnetic element or magnetized mass of any kind.

In the accompanying drawings, Figure 1 is a front elevation of an arc electric lamp embodying my invention in its preferred form. Fig. 2 is an axial section of the same to a larger scale, omitting the negative electrode. Fig. 3 is an axial section of the upper part of the same, taken at right angles to Fig. 2. Fig. 4 represents to a yet larger scale my electrode-lifter or solenoid. Fig. 5 is a fragmentary elevation to a still larger scale, representing portions of my three concentric helices. Fig. 6 is a partly-sectioned elevation, representing my triple arrangement of concentric helices adapted for use with an electrode-lift of shorter effective range than the working length of the positive electrode.

The lamp proper, irrespective of the equalizing attachment, may be substantially as described in my patent aforesaid, in which the positive wire or rheophore A from the generator (or from line or a preceding lamp, as the case may be) connects, by binding-post B upon non-conducting collar E, with a stationary coil or helix, C, of insulated wire, which is wound as a single layer around a non-magnetic metal bobbin, D, whose ends are secured in the non-conducting collars E F.

A metallic pendant, G, attached to lower collar, F, supports and has electrical connection with the lower or negative electrode, which may be either of refractory metal, as at I, or of carbon.

The positive electrode J is attached by clamp K to lower extremity of a brass rod, L, whose upper extremity has continuous metallic connection with a helix, M, (called in this specification the "solenoid,") of the same kind and thickness of insulated wire as composes the prime helix, the direction of the convolutions being such as that the neighboring currents in the two helices move in the same direction, the diameter of said solenoid being such as to nearly fill without touching the interior of the prime helix.

The helix M is attached at its lower end to a tube, N, within which rod L is confined axially by insulating-plugs O, and this tube is attached at bottom to a cross-bar, P, from which extend upward two rods, Q, of spring-brass, which, traversing orifices *f* in collar F, are surmounted by brass wheels R, that occupy and travel upon bared tracks *c* on prime helix C.

One or more chains, S, attached to top of the solenoid, pass over as many sheaves, T, to counterpoises U, whose aggregate weight is such as to nearly balance that of the solenoid and its attachments, the weight of the chains itself being such as to just compensate for the diminishing weight of the gradually-consuming carbon by the transfer of successive portions of the chains from the outside to the inside of the prime helix.

A non-magnetic bobbin, V, is so attached by clamps W to the rods Q as to surround concentrically, in close proximity, without actual contact with, the prime helix C. Slots *v* in this bobbin permit the wheels R to extend through the bobbin-walls sufficiently to occupy the bared tracks *c*.

X is our insulated wire of high resistance. The said high-resistance wire has electrical communication by its lower extremity through the parts Q P N M L K with the positive electrode, and by its other extremity with the generator or the next lamp of the series, as the case may be, and is so wound upon the bobbin V as, when conveying current, to set up current-repulsion between the helix thus formed and the prime helix. This high-resistance helix X, called the "differential," and the solenoid M are respectively attached to the electrode-holder at or about the represented relative altitudes, and the slight preponderance of weight of the holder and its appendages causing the centers both of solenoid and differential energy to be always below that of the prime helix, it follows that the solenoid has always an upward tendency proportionate to the activity of the main current, and that the differential has always a downward tendency proportionate to the activity of the overflow. Hence the differential, whenever energized by an overflow, tends to move in the opposite direction to the solenoid-lift, and both differential and solenoid being rigidly attached to the positive-electrode holder, it follows that said differential, although not sensibly affecting the mutual current affinities of the prime helix and the solenoid, nevertheless exerts a mechanical pull downward, which to the extent of its force for the time being antagonizes to a greater or less degree the lift of the solenoid.

To permit unrestricted play of the two shifting-helices, that portion of the differential wire which connects the differential helix with the negative binding-post Y takes the convoluted form shown at X′. The differential may be restricted to its proper vertical path by rods Z, stretched from collar E to collar F′, and occupying perforated lugs *v*′, that project from

the bobbin V. The differential bobbin, being thus accurately guided, becomes effective to hold the shunt-wheels R to their tracks *c*.

The escape of current from negative electrode may be by way of pendant G, and thence by the bobbin of the prime helix, as shown, or by a special wire. The direction of the positive current is indicated by arrows.

An inferior modification of my arrangement of triple helices, which adapts it for lamps whose capacity for armature-range is less than the effective working length of the positive electrode, is shown at Fig. 6. In this form there is neither bared track nor sliding shunt-wheel. The prime helix is much shorter than the full length of the positive electrode, and, as usual with such short helices, may consist of several layers. The magnetic field, as customary with such short helices, is co-extensive with the helix, and mechanical communication between armature and electrode is intermittent.

In the present illustration the desired result is shown to be accomplished by an annular clutch, 2, similar to that patented to Charles F. Brush; but any suitable fast-and-loose mechanism will answer the purpose. The form shown in Fig. 6 is susceptible of a further modification by substitution of an induced magnet or armature for the current-carrier or solenoid.

I have shown and prefer a negative electrode of refractory metal, but reserve the right to employ a negative of the same material as that of the positive, and may associate therewith any customary device for simultaneous feed of the two electrodes.

I claim as new and of my invention—

1. In an arc electric lamp in series, the combination of the following elements, to wit: three concentric helical current-carriers, of which the intermediate one, called the "prime helix," is fixed, and has at its upper end electrical communication with the positive rheophore and at its lower end with the positive electrode, and of which the other helices are mechanically connected to and travel with the positive electrode, one of said traveling helices, called the "solenoid," being of like resistance with the prime helix and in circuit with the electrodes, and so wound as to be attracted by said prime helix with force proportional to their common current, the other traveling helix, called the "differential," being of high relative resistance, and so connected with line beyond the arc as to divert current or overflow therefrom, and so wound as (during overflow) to be repelled by said prime helix, and thus to counteract or overcome to a greater or less extent, proportionate to the overflow, the lifting action of said solenoid, and thereby facilitate transmission of current to the other lamps of the series, substantially as and for the purpose set forth.

2. In an arc electric lamp in series, the combination of the following elements, to wit: three concentric helical current-carriers, of which one, called the "prime helix," is fixed, and is connected at or near its upper part with the positive rheophore, and below such connection communicates, by one or more bared tracks on its exterior periphery and by shifting conductor in contact with said tracks, with the positive electrode, and of which the other helices are attached to and travel with said conductor, one of said traveling helices, called the "solenoid," being of like resistance to the prime helix and in circuit with it and the electrodes, and so wound as to be attracted by said prime helix with force proportionate to their common current, the other traveling helix, called the "differential," having a relatively-high resistance, and so connecting said conductor with line beyond the arc as to divert current therefrom, and so wound as (during overflow) to be repelled by said prime helix, substantially as and for the purpose set forth.

3. In an arc electric lamp in series, the combination of the following elements, to wit: three concentric helical current-carriers, of which one, called the "prime helix," is fixed, and is connected at or near its upper part with the positive rheophore, and below such connection is connected, by one or more bared tracks on its exterior periphery and by shifting conductor in contact with said tracks, with the positive electrode, and of which the other helices are attached to and travel with said conductor and said electrode, one of said traveling helices, called the "solenoid," being of like resistance with and interior to said prime helix and in circuit with it and with electrodes, and so wound as to be attracted by said prime helix with force proportionate to their common current, the other traveling helix, called the "differential," surrounding the prime helix and having a higher resistance than the normal arc, and connecting the said conductor with line beyond the arc, so as to divert current therefrom, and so wound as (during overflow) to be repelled by said prime helix, and thus to counteract or overcome to a greater or less extent, proportionate to the overflow, the lifting action of the central helix and to facilitate transmission of current throughout the series, substantially as set forth.

In testimony of which invention I hereunto set my hand.

WILLIAM M. THOMAS.

Witnesses:

GEO. H. KNIGHT,

SAML. S. CARPENTER.