(No Model.)

D. HIGHAM.

ELECTRIC ARC LIGHTING SYSTEM.

No. 520,232. Patented May 22, 1894.

FIG. 1.

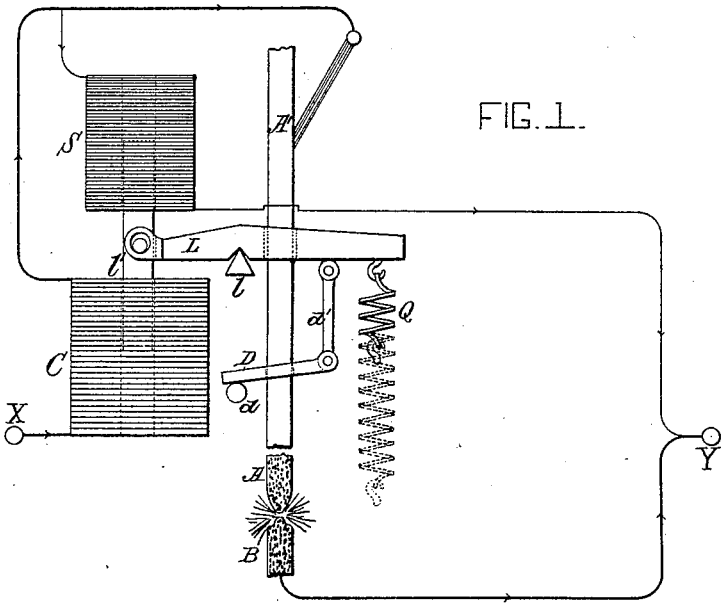


FIG. 3.

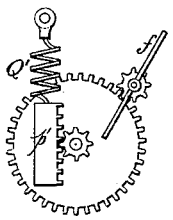


FIG. 2.

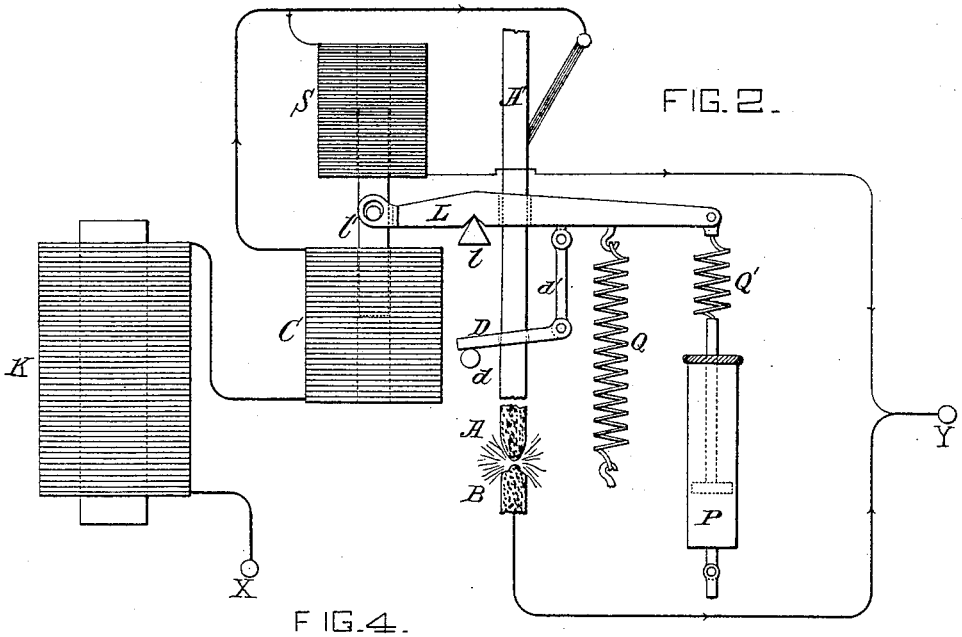
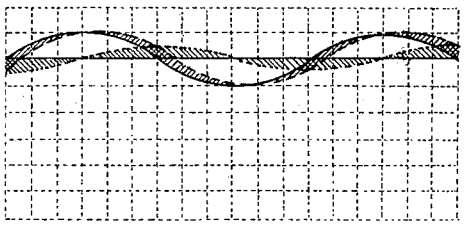


FIG. 4.



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ELECTRIC-ARC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 520,232, dated May 22, 1894.

Application filed January 2, 1894. Serial No. 495,363. (No model.)

To all whom it may concern:

Be it known that I, DANIEL HIGHAM, a citizen of the United States, and a resident of Boston, Massachusetts, have invented Improvements in Electric-Arc-Lighting Systems, of which the following is a specification.

This invention relates to electric arc-lighting, but more particularly to multiple or constant potential arc-lighting, and its object is to provide means whereby little or no resistance will be required in the arc branch to obtain "stability" of current, as will be best understood by the following explanation and by reference to the accompanying drawings, in which—

Figure 1 is a diagram of a form of clutch lamp, shown for purpose of illustration. Fig. 2 is a similar diagram showing my invention as correctly applied. Fig. 3 is a view of a modification; and Fig. 4 is a diagram illustrative of the performance or operation of my improvement.

In the diagrams, Figs. 1 and 2, A represents the upper carbon carried by a movable holder A′, while B represents the lower or fixed carbon. Acting upon the movable carbon holder is a clutch D, one end of which touches upon a stop *d* on the frame, while the other end is connected through a link *d′* to a lever L pivoted at *l*.

S is a fine wire coil in a shunt circuit around the arc and acting magnetically upon solenoid core *l′*.

C is a coarse wire coil in the main circuit, and also acting magnetically upon solenoid core *l′*, but tending to move it in an opposite direction to that imparted by coil S.

Q is an adjustable spring to act upon lever L against the magnetization of coil C.

In Fig. 2, coil K is a coil of high self-induction connected in the main circuit, in series with the arc and series windings C of the lamp, while Q′ is a short spring, acting both for tension and compression, connecting lever L through a dash-pot P to the frame of the lamp. The circuits between the terminals X Y of the lamp, shown in both diagrams, are indicated by arrow heads.

I have discovered that a very marked condition of "stability" is obtained when spring Q is made very short, as shown in Fig. 1, and that best results for "stability" are obtained when the same is made sufficiently short (so as to increase sufficiently in tension when stretched) to prevent increase of current from lengthening the arc by means of the series coil C, more than would just be necessary to prevent a fall of electric potential at the arc when the current intensity rises. Under this adjustment, in connection with multiple arc-lighting, a lamp would run with less "pumping" or "hammering" in the sense meant by "instability," but there would be a very serious objection produced in another direction, amounting to prohibition of the short spring. For instance, on the first drawing of the arc, in lighting the lamp, an almost infinitely great amount of current would be required to pass through coil C to draw the necessary length of arc to check the heavy rise of current occasioned by the rapidly increasing tension of the short spring as the arc is being lengthened. In fact, if the spring Q be made sufficiently short to obtain the maximum condition of "stability" the drawing of the arc would almost amount to a theoretical impossibility; at best the lamp would burn at very great varying degrees of candle power, first being abnormally bright and then getting less bright as the carbons burn away, until it would get, perhaps, below the normal candle power, when carbon A would feed down slightly and up would go the candle power again. The same thing would be repeated, only not to such a great extent, at every feeding of the carbon. With the long spring Q now made use of as shown in dotted lines in Fig. 1, it will be understood that only a slight increase of current is required in coil C above the normal to draw the arc to the full length, inasmuch as the long spring Q gains but little in tension when stretched; whereby the lamp would burn at a practically uniform brilliancy although more resistance would be required in the arc branch to obtain "stability" than would be the case with the short spring. It is the object of this invention, however, to provide means whereby a short and long spring can be used in one lamp. Fig. 2 of the drawings will serve to show how this can be carried out. Q is the long spring shown in dotted lines in Fig. 1, while Q′ is a spring acting

both for tension and compression, and arranged to serve the purpose of the short spring in limiting the movement of lamp magnet mechanism in the lengthening or shortening of the arc, considering the dash-pot P as a fixed connection. As the dash-pot connection however, will be a slow yielding one, the long spring (Q) adjustment will be allowed to slowly take effect, that is, the dash-pot P will allow the proper length of arc to be slowly drawn and the brilliancy to be practically kept constant; while spring Q′ will prevent the lamp-magnet mechanism from moving quickly more than would just be necessary to prevent a fall of electric potential at the arc when the current intensity rises, or a rise of potential when the current falls.

The high self-induction coil K shown in Fig. 2, together with the short spring Q′ and dash-pot P constitute my present invention.

The operation or performance of my improvement is graphically illustrated in diagram Fig. 4, and is as follows: The full curved line in the diagram represents a wave variation of current flowing through coil K and lamp, the line of dashes, the resultant movement of the carbon A and holder A′ in lengthening and shortening the arc under the limiting action of the short spring Q′—considering the dash-pot P as a fixed connection, and the dotted line indicates the drop and fall of potential at the arc due to coil K, while the straight line indicates the normal condition of all; the duration of time is laid off along the abscissas and the intensity of current, the drop and fall of potential due to coil K, and movement of the upper carbon, along the ordinates. From this diagram it will be seen that the movement of the upper carbon is slightly behind in phase of the current flowing through the lamp (which is occasioned by the inertia and friction of the movement of lamp-magnet mechanism), and consequently leaving a slight deficiency between the current and the lengthening and shortening of the arc, as indicated by the cross-hatches, shown in the diagram. Now the self-induction offered to the current by coil K will be precisely one quarter of a wave difference in phase from the wave variations of current flowing through the lamp, as shown by the dotted line in the diagram; from which it will also be seen that the said deficiency between the current and movement of the upper carbon can be readily compensated for by the drop and fall of electric potential at the arc, occasioned by the self-induction of coil K, as also indicated by cross-hatches, whereby, if coil K is sufficiently large, "stability" of current will be obtained within a small wave variation of about two per cent. or three per cent., as will be understood without further description.

Other forms of slow yielding connection may be employed in place of the dash-pot. Thus, in Fig. 3, I have shown a rotating fan *f* mounted in bearings in the frame geared up to a rack *p′*—,which is connected to the spring Q′.

Although I have shown but one form of lamp embodying my improvements, it should be understood that various other forms and arrangements or modifications of parts could be easily devised by any one skilled in the art without departing from the scope of my invention.

For greater clearness I may explain that in the specific example illustrated in Fig. 2, the spring Q′ is the "elastic connection" feature of the claim which follows, while the dash-pot P or its equivalent is the "slow yielding connection," and the coil K is the "inductive coil."

I claim as my invention—

The combination of an arc-lamp or lamps having suitable carbon feeding or regulating mechanism, with an inductive coil in the main circuit in series with the arc and series windings of said lamp or lamps and an elastic and slow yielding connection arranged serially together between the said mechanism and frame of said lamp or lamps, substantially as described and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

DANIEL HIGHAM.

Witnesses:
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