(No Model.)

D. HIGHAM.

ELECTRIC ARC LIGHTING SYSTEM.

No. 510,260. Patented Dec. 5, 1893.

FIG. 1.

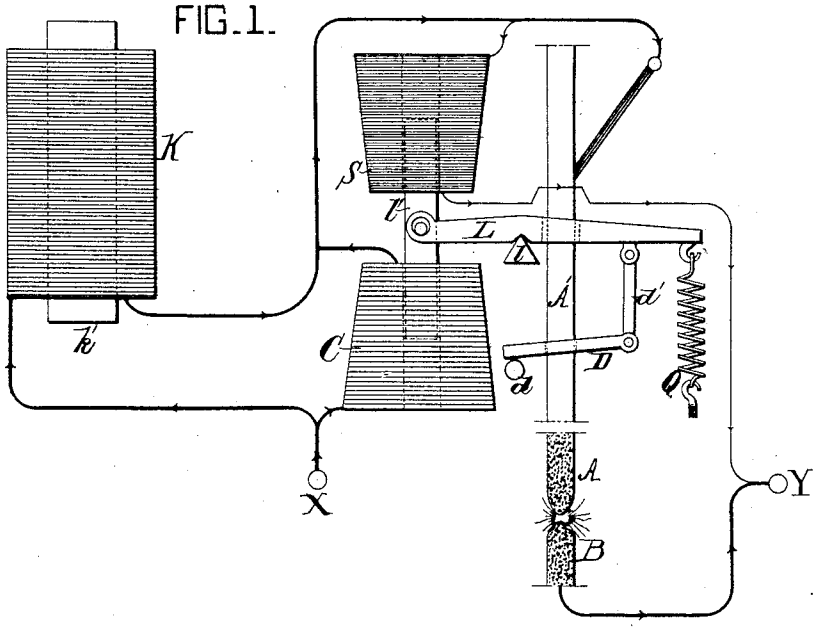


FIG. 2.

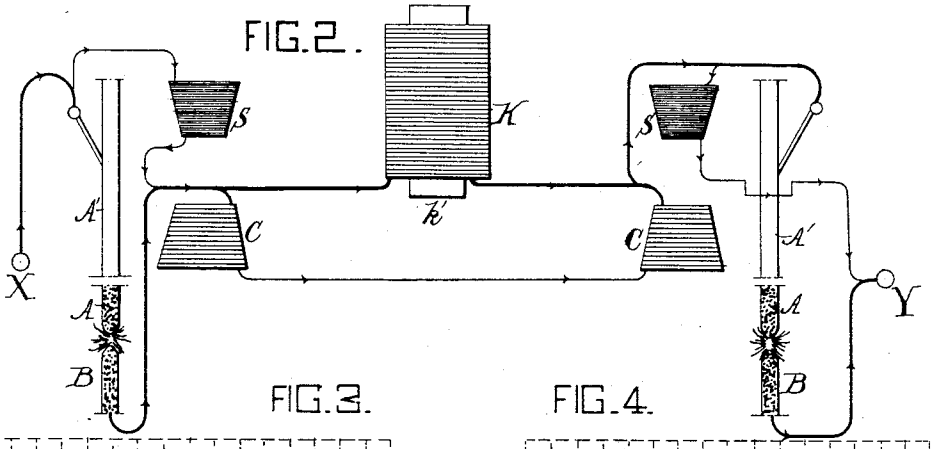


FIG. 3.

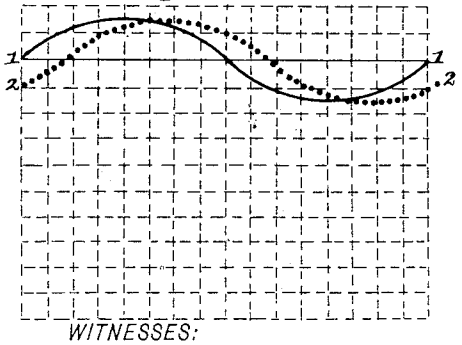
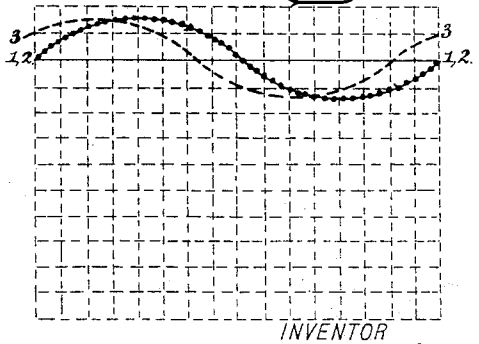


FIG. 4.



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ELECTRIC-ARC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 510,260, dated December 5, 1893.

Application filed July 6, 1893. Serial No. 479,700. (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, Suffolk county, Massachusetts, have invented an Improvement in Rendering Arc-Light Currents Stable, of which the following is a specification.

This invention relates to electric arc lighting and its object is to provide means, whereby the current supplied to arc lamps will be "stabled," that is rendered stable, by the action of the lamp magnet mechanism, as more fully described hereinafter. An electric arc possesses this curious property—that the electric potential required to sustain it falls with increase of current intensity and rises with decrease of current intensity. For this reason it is an impossibility to supply an arc of given length, under constant potential; for it would either take an infinitely great amount of current or else extinguish itself entirely. Theoretically the potential of an arc could be made to rise with increase of current and fall with decrease of current, by lengthening and shortening the arc, as by lamp-magnet mechanism; but so far such an action has not been practically carried out, because it has always been behind time in its movement and a condition of instability has always resulted in consequence. This instability is overcome in multiple arc-lighting by inserting a resistance (which usually consumes about twenty-five per cent. of the power taken by a lamp) in each arc branch, in order that increase of current will require a slight increase of potential and decrease of current a slight decrease of potential, at the terminals of the branch; whereby, if the potential is constant at the mains stability will be obtained, as is well known to the art. It is the object of this invention, however, to accomplish stability of current without this resistance in the branch, by making the current which controls the lamp-magnet mechanism wave ahead in phase of wave variations of current flowing through the arc, as will be best understood by the following explanation in connection with the accompanying drawings, in which—

Figure 1 represents diagrammatically a simple form of clutch lamp embodying my invention; Fig. 2 a diagram of circuits forming a modification, and Figs. 3 and 4 diagrams for illustration.

Diagram Fig. 3 will serve to illustrate the lag or loss of time in the movement of the lamp-magnet mechanism of arc lamps such as now in use. The full curved line 1 in the diagram represents a wave variation of current flowing through the arc and also operating the lamp-magnet mechanism, the heavy dotted line 2, the movement of the lamp-magnet mechanism and the straight or horizontal line the mean or normal intensity of current and position of the lamp-magnet mechanism; the duration of time being illustrated by the ordinates and the intensity of current and movement of the lamp-magnet mechanism by the abscissæ. From this diagram it will be seen that the length of the arc, if controlled by the lamp magnet mechanism will not be lengthened or shortened with the current flowing through the arc.

Diagram Fig. 4 will serve to illustrate the method, which forms the subject matter of this application, of operating the lamp-magnet mechanism in order to lengthen and shorten the arc with the rise and fall of current flowing through the same. The dash line 3 represents the wave variation of an independent current, differing in phase from the current flowing through the arc, and operating the lamp-magnet mechanism,—the rest of the diagram being as in diagram Fig. 3. From this diagram it will be seen that the movement of the lamp-magnet mechanism, if the "lag" is allowed to be the same as in diagram Fig. 3, will be in time, or as graphically shown, in phase with the current flowing through the arc. It should be understood, however, that the curves shown in the diagrams are not intended to represent the exact operation of arc-lamps now in use, or of the means described in this specification, but are shown for clearness of illustration.

A form of lamp and means for producing the operation of lamp-magnet mechanism illustrated in diagram 4 is shown in Fig. 1 of the drawings.

A represents the upper carbon carried by a movable carbon holder A′, while B represents the lower or fixed carbon. The upper movable carbon and carbon holder are controlled

by 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.

K is a coil possessing high self-induction, in the main circuit, and having a laminated core k'. Shunted from coil K is a coil C acting magnetically upon a solenoid core l', carried by lever L.

S is a fine wire coil in a shunt circuit around the arc and also acting magnetically upon solenoid core l', but tending to move it in an opposite direction to that imparted by coil C.

Q is an adjustable spring which may be employed to act upon the lever L against the magnetic action of coil C. The circuits between the terminals X Y of the lamp are sufficiently indicated by arrows.

The operation is as follows:—If the current flowing through the lamp should tend to be unstable or wave in intensity unduly, the resistance to the current, of coil K and coil C would be caused to vary in respect to each other, inasmuch as the self-induction of coil K is higher than coil C, and, as it will take longer for the current to change in coil K than it will in coil C, the phase difference in the current wave of coil C would be caused to be ahead in phase of the current wave in coil K, that is to say, in the direction the dash line 3 is to the full line and dotted line in diagram Fig. 4. From this it can be readily seen and understood that coil C will operate the lamp-magnet mechanism, allowing for the same amount of "lag" shown in diagram Fig. 3, somewhere with the wave variation of current flowing through the arc; whereby "stability" would be obtained, within a very small wave variation according to sensitiveness of the lamp-magnet mechanism, without the use of any or with very little "resistance" in the arc branch. The feeding down of carbon A to maintain the desired length of arc is under control of coil S, as will be understood; although coil S, it might be mentioned, is not an absolute necessity unless more than one lamp is run in one branch.

The fact of the difference in phase between the current wave variation of two coils in parallel, one possessing high self-induction and the other very low self-induction, is well known to the art, and it is therefore not deemed necessary to give further or elaborate description here.

This invention, it should be understood, consists broadly of the method of operating lamp-magnet mechanism by a current waving ahead in phase of current wave variations flowing through the arc. Fig. 2 shows a modified arrangement of connections or circuits in which one coil K can be made to operate two lamps, as will explain itself; the same parts being marked with the same letters of reference as in Fig. 1.

The coil or coils C shown in the drawings, as used in the lamps now in use are connected in the main circuit or in series with the arc (coil K, of course not being used at all) and are called the "series coils." In connection with this invention the coils C as shown are not directly or wholly in the main circuit, still they take the place of the "series coils" and I therefore wish to refer to them in the claims of this application as "series acting coils"—meaning the coils which tend to lengthen the arc. The method herein described of operating the lamp-magnet mechanism is also applicable to "series arc lighting" and will secure stability of current without the need of any or with very little of the properties of stability which are now given to the dynamos used in connection with this system, namely, the working down on the "dip of the characteristic" of the dynamo, which is compulsory for the successful working of the system and is obtained at a sacrifice of efficiency and at an increased cost of the dynamo, as is well known to the art.

Although I have illustrated but one form of arc lamp mechanism in connection with my method of operating the lamp-magnet mechanism, it should be understood that various other forms may be employed.

I claim as my invention—

1. The mode herein described for rendering stable the current taken by arc lamps, said mode consisting of producing in the "series acting coils" of the lamps current wave variations differing in phase from the current wave variations of current flowing through the lamps.

2. The combination of an arc lamp or lamps provided with suitable carbon-feeding mechanism, with means for producing in the "series acting coils" of the lamp or lamps current waves differing in phase from the wave variations of current flowing through the lamp or lamps, and acting upon the lamp-magnet mechanism of the lamp or lamps to render stable the current taken by the same, substantially as described.

3. The combination of an arc lamp or lamps provided with suitable carbon-feeding mechanism, with a coil of high self-induction connected in parallel with the "series acting coils" of said lamp or lamps, substantially as and for the purpose described.

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

DANIEL HIGHAM.

Witnesses:
J. D. YOUNG,
E. T. HIGHAM.