

D. HIGHAM.

REGULATOR FOR CONTINUOUS CURRENT ARC LIGHT CIRCUITS.

No. 512,027.

Patented Jan. 2, 1894.

Fig. 1.

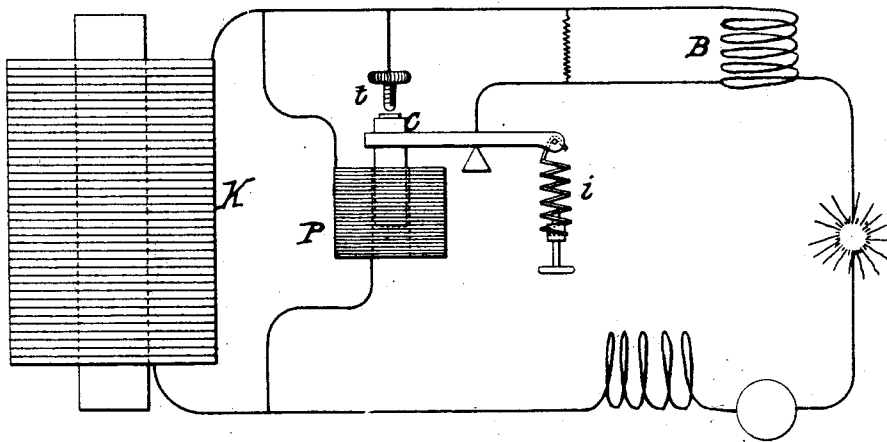


Fig. 2.

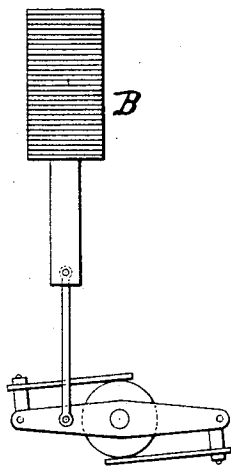
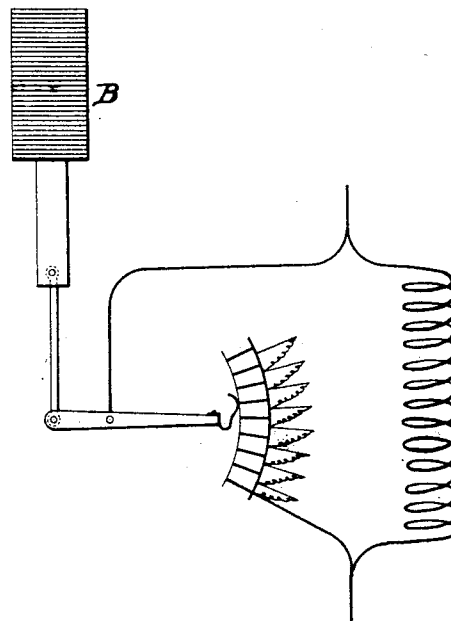


Fig. 3.



WITNESSES:

George Baumann
James Gracie

INVENTOR:

Daniel Higham
BY
Howson and Howson
his ATTORNEYS.

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Fig. 4.

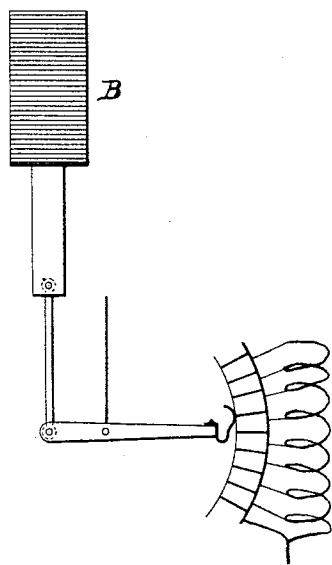


Fig. 5.

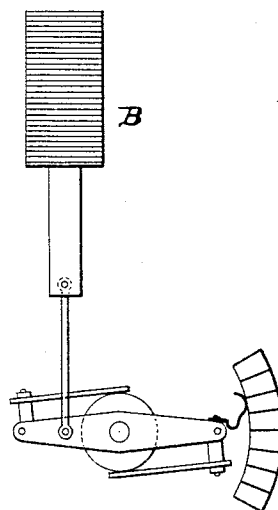


Fig. 6.

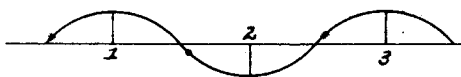


Fig. 7.

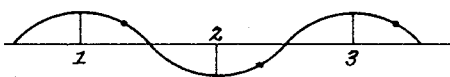
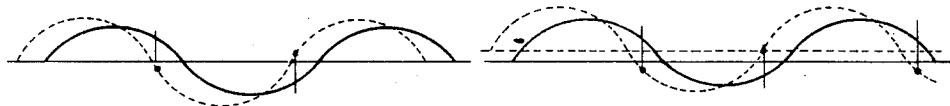


Fig. 8.



Fig. 9.



WITNESSES:

George Baumann
James Grace

INVENTOR:

Daniel Higham

BY

Howard and Howard
his ATTORNEYS.

UNITED STATES PATENT OFFICE.

DANIEL HIGHAM, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE HIGHAM ELECTRIC COMPANY, OF PORTLAND, MAINE.

REGULATOR FOR CONTINUOUS-CURRENT ARC-LIGHT CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 512,027, dated January 2, 1894.

Application filed May 14, 1892. Serial No. 433,055. (No model.)

To all whom it may concern:

Be it known that I, DANIEL HIGHAM, a citizen of the United States of America, and a resident of Boston, Massachusetts, have invented the Improvements in Rendering Stable and in Regulating Arc-Light-Current Circuits, of which the following is a specification.

This invention relates to that method of obtaining stability of current in arc-light circuits which I have illustrated in Reissued Letters Patent No. 11,108, dated August 26, 1890; and the object of this invention is to provide for its more effectual carrying out, as fully described hereinafter.

Figure 1 of the drawings represents a form of means embodying the main features of this invention. Figs. 2, 3, 4 and 5 represent different forms or modifications of controlling mechanism which may be used, and Figs. 6, 7, 8 and 9 are diagrams for illustration.

Diagram 6 represents the existing method, excepting the method described in said reissued Letters Patent, of operating the controlling mechanism of arc-light dynamos; and which consists of checking a rise of current intensity after the current rises above normal intensity and of checking a fall of current intensity after the current falls below normal intensity.

Diagram 7 represents the method of operating the controlling mechanism of arc-light dynamos which I have described in said reissued Letters Patent; and which consists of checking a rise of current intensity before the current rises to normal intensity, and of checking a fall of current intensity before the current falls to normal intensity.

The star (*) in the diagrams indicates the point in the variation of current intensity, where the controlling mechanism starts to move to check a rise of current intensity, while the dot (.) represents the point where the controlling mechanism starts to move to check a fall of current intensity.

The wave line represents the variation of current intensity, and the straight line represents the mean or normal intensity, while the small ordinates will serve to illustrate the duration of time.

Before going too fully into the subject matter of this application it will be well to give

a brief illustration of the above two methods of operating the controlling mechanism of arc-light dynamos, in order that the distinction between the two can be more clearly understood when reference is made to them herein. If from ordinate 1 to ordinate 2 in Diagram 6 is the time when the current intensity is falling it will be seen that more than half of this time will be spent before the controlling mechanism will start to move to check the fall of current intensity and if from ordinate 2 to ordinate 3 is the time when the current intensity is rising it will be seen that more than half of this time will be spent before the controlling mechanism will start to move to check the rise of current intensity. The first mentioned method of operating the controlling mechanism of arc-light dynamos, therefore, could not stable the current, inasmuch as the current intensity would have to keep on falling or rising in each variation until the time after the controlling mechanism started to move would be somewhat more than the time spent before the controlling mechanism started to move, whereby the wave or variation of current intensity would be increased at every oscillation or movement of the controlling mechanism until the extreme conditions of instability would be reached. It should be understood, however, that the above is not intended to mean that the current of an arc-light dynamo would be made unstable by the method of operating the controlling mechanism shown in Diagram 6, for if the dynamo had sufficient properties of stability to make up for the defects in this respect in the operation of the controlling mechanism, the current, would of course be stabled; what is intended to be meant is that the method of operating the controlling mechanism shown in Diagram 6 is a method which possesses no properties of stability in itself; a method which would only act to maintain a constant mean intensity of current. Now if from ordinate 1 to ordinate 2 in Diagram 7 of my patented method is the time when the current intensity is falling it will be seen then that the time spent before the controlling mechanism has started to move will be very little compared to the time which will be spent after the controlling mechanism has started to

move in checking the fall of current intensity, and if from ordinate 2 to ordinate 3 is the time when the current intensity is rising it will be seen that the time spent before the controlling mechanism has started to move will be very little compared to the time which will be spent after the controlling mechanism has started to move in checking the rise of current intensity. The second mentioned method of operating the controlling mechanism of arc-light dynamos, therefore, would stable the current, inasmuch as the wave variation of current intensity would be shortened at every movement or oscillation of the controlling mechanism until the wave would become very small, that is to say, a wave or undulation of about two or three per cent. variation, as will be apparent. The advantage of this method of operating the controlling mechanism of arc-light dynamos is that the dynamo can be made to possess some properties of instability and, as described in said reissued Letters Patent, to yield a higher efficiency and at a lower cost of manufacture in consequence.

The first mentioned method of operating the controlling mechanism, which is the method shown in Diagram 6, I shall herein refer to as a method "acting to regulate the current," and the second method of operating the controlling mechanism which is shown in Diagram 7, I shall herein refer to as a method "acting to stable the current."

One form of means embodying the main features of this invention I have shown in Fig. 1 and it consists of a coil K of high self-induction connected in the main or working circuit, a coil P of low self-induction, compared to coil K, connected in parallel circuit with coil K, a contact *t* in a short circuit around controlling mechanism B, and spring *i* to oppose the attractive force of coil P and adjusted so that the contact *t* will open when the current intensity in the main or working circuit rises above normal and close it when the current intensity falls below normal.

The operation is as follows:—If the current flowing through coils K and P were varied or waved in intensity the resistance to the current in each coil would vary in respect to each other, inasmuch as the self-induction of one is higher than the other, and as it will take longer for the current to change in coil K than it will in coil P, which is in the branch circuit, it follows that the phase difference in the current wave of coil P will be ahead of the current wave in coil K and working circuit, that is to say, ahead in time, or in other words in the direction the dotted line is to the full line in Diagram 8. Now supposing the full line in Diagram 8 to be the wave of current intensity in the main or working circuit, and the dotted line the wave of current intensity in coil P as displaced in phase by coil K, it can be clearly seen when the contact *t* will be opened and closed and also when the movement of the controlling mechanism

will start to move to check a rise or fall of current intensity in the main working circuit, which is indicated in the diagram by the dot (.) and the star (*) with small ordinate carrying the point of time to the variation of current in the main or working circuit. This it will be seen is the method of operating the controlling mechanism represented graphically in Diagram 7. In other words this action of the means shown will be to stable the current.

In order to regulate the current it will be necessary to make the dead resistance of coils K and P remain constant or vary with each other, for instance the variation of temperature of each must be made to vary the same, in order that the coil P in the branch circuit shall always have a definite mean intensity of current when there is the desired or normal intensity in the main or working circuit, that is to say, if the coil K was devoid of its self-induction, the wire resistance of coils K and P should be such that the current flowing through coil P would act precisely the same as though it was in the main circuit to regulate the current as shown in Diagram 6.

In Diagram 9 I have illustrated the action of the means shown when the mean intensity of current rises above the desired or normal intensity, from which it will be seen that the contact *t* will be then held a little longer open than closed, and as will be understood, will on the other hand be held a little longer closed than open when the mean intensity of current falls below normal.

Fig. 2 represents the controlling mechanism B as consisting of means for shifting the commutator brushes, of the supply generator.

Fig. 3 shows means for effecting the control by varying a resistance around the field magnet coils.

Fig. 4 shows means for effecting the control by cutting in and out sections in the field magnet coils.

Fig. 5 shows means for effecting the control by varying the field magnet intensity and shifting the commutator brushes at the same time. The operation of these devices will be understood. There are also other forms of means besides those shown in Fig. 1 which would embody the main features of this invention, but as the precise form of means has nothing to do with the real scope of this invention it will not be necessary to illustrate them.

I claim as my invention—

1. The combination of a current controlling device for arc-light circuits with means for producing in a branch circuit current waves differing in phase from current waves in the main or working circuit and adapted to act upon said current controlling device to render stable and to regulate the main or generated current.

2. The mode herein described of rendering the current in arc-light circuits stable, said mode consisting in producing in a branch

circuit by the action of the current in the
main circuit current waves differing in phase
from current waves in the main or working
circuit, and controlling the current in the
5 main circuit from the variations in the said
branch.

In testimony whereof I have signed my

name to this specification in the presence of
two subscribing witnesses.

DANIEL HIGHAM.

Witnesses:

H. GREGORY, Jr.,

DANIEL B. WHITTIER.