(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 324,502. Patented Aug. 18, 1885.

Fig. 1.

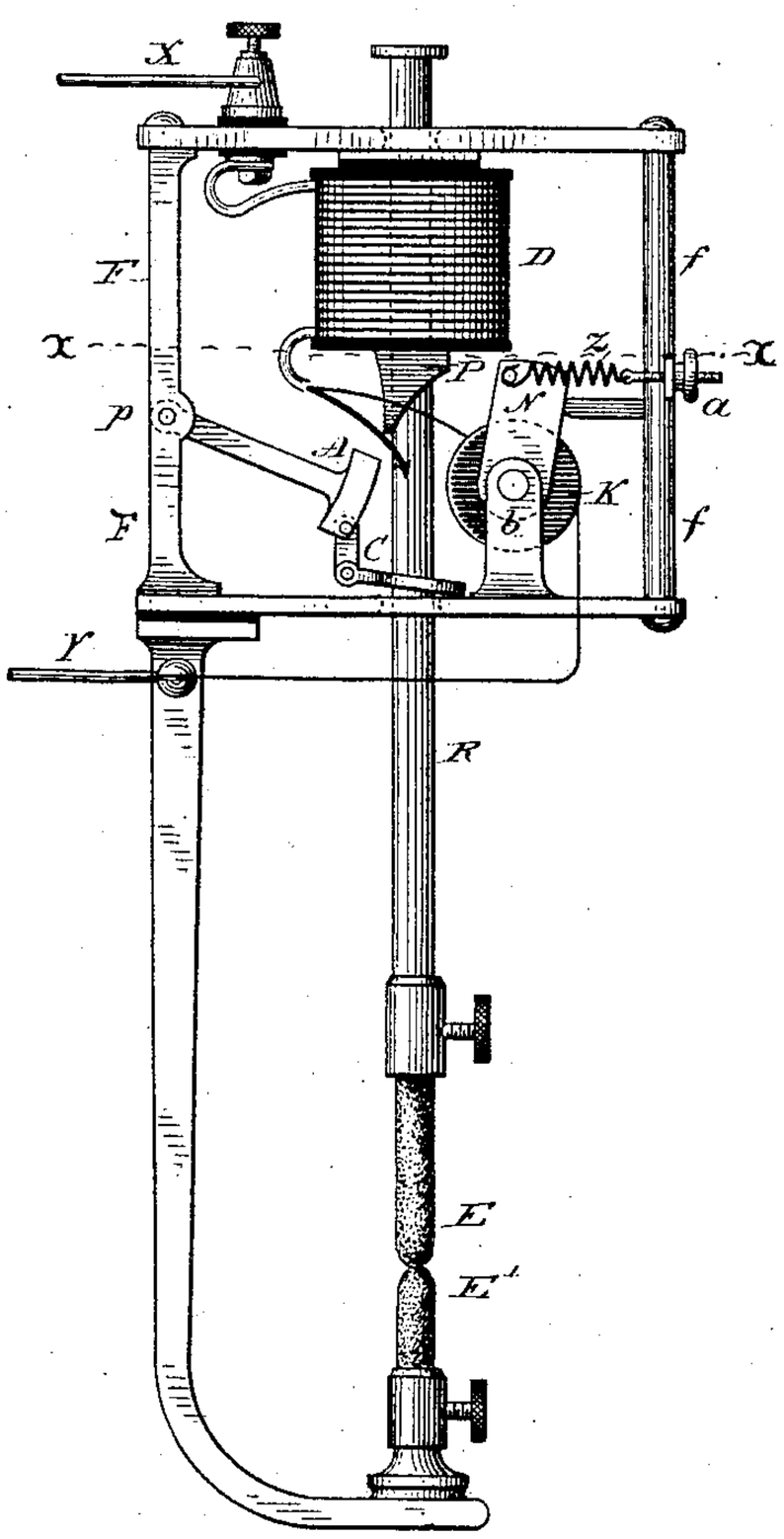

Fig. 2.

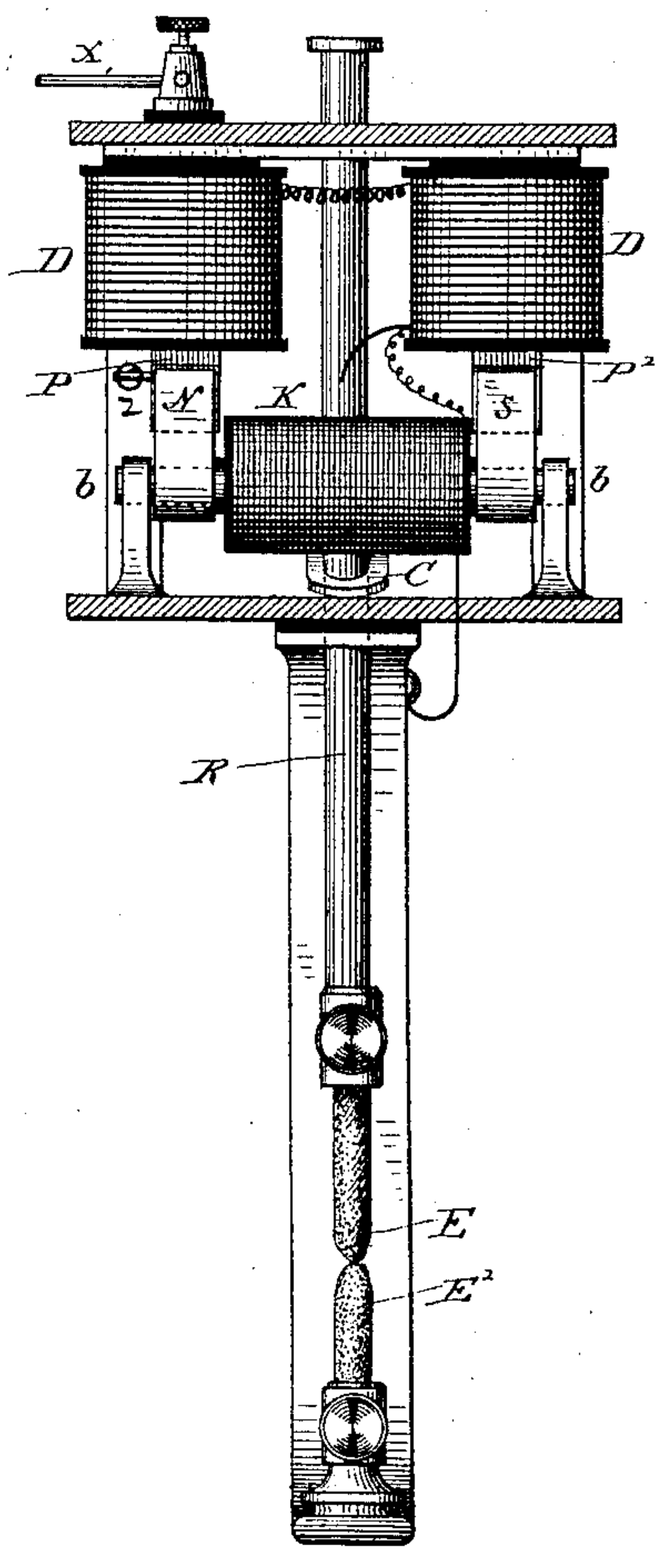

Fig. 3.

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

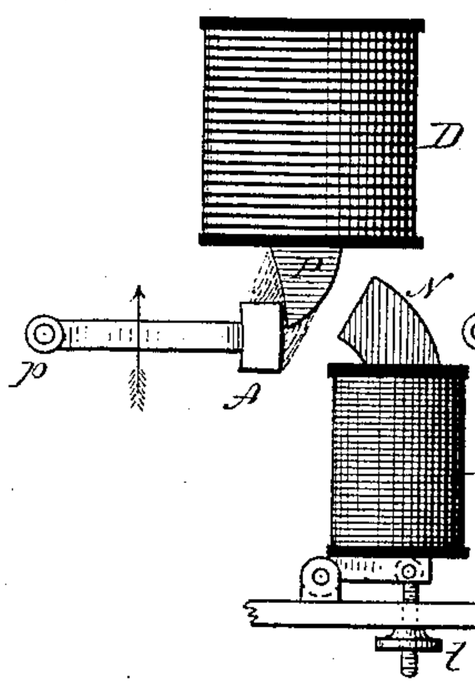


Fig. 6.

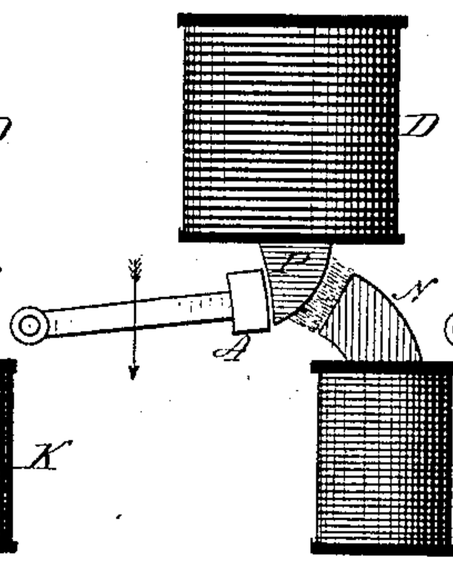


Fig. 7.

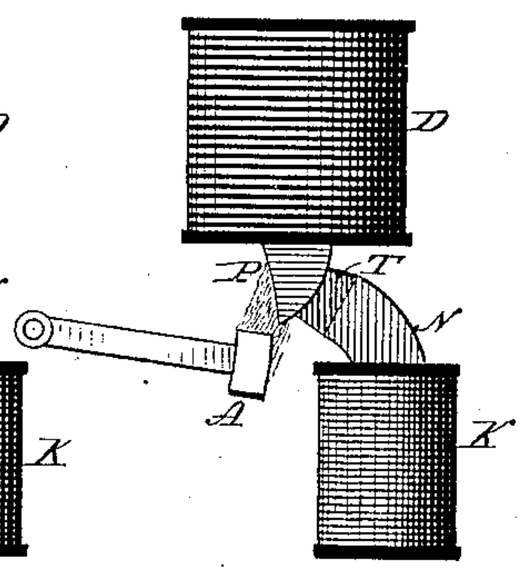


Fig. 8.

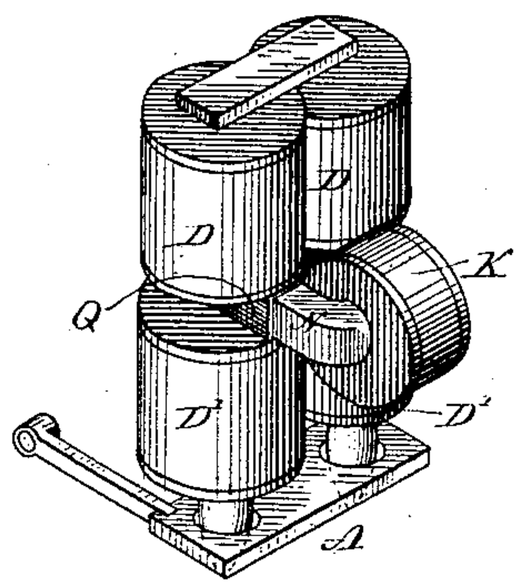


Fig. 9.

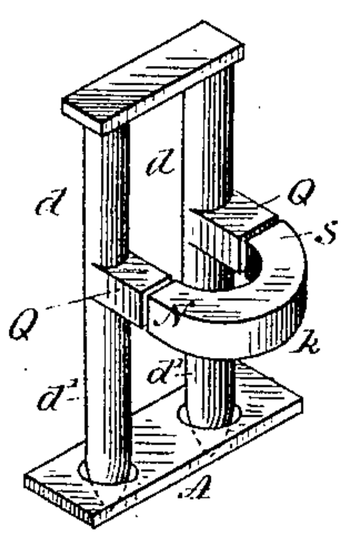


Fig. 10.

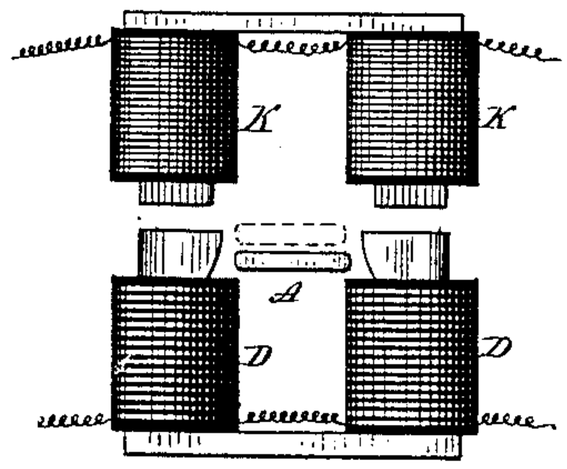


Fig. 11.

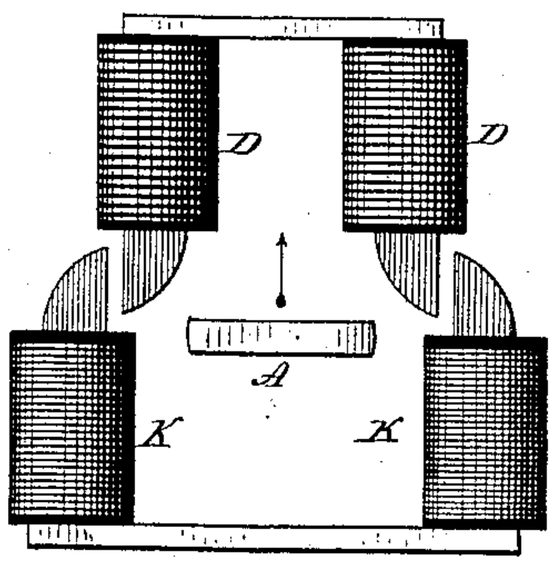
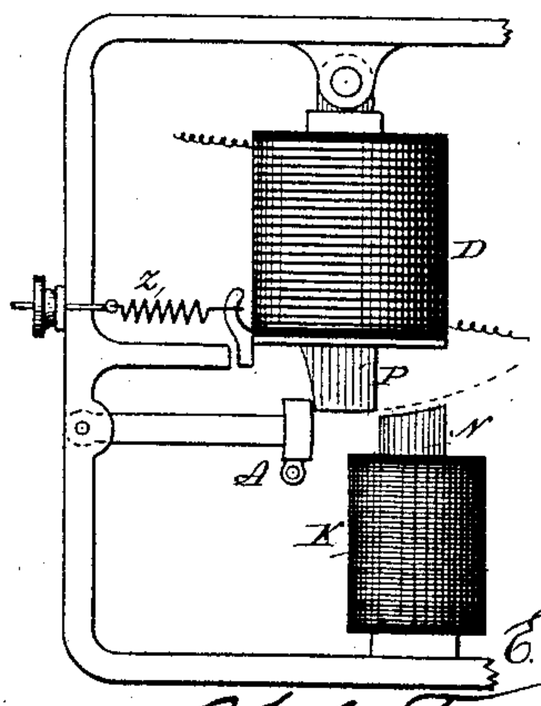


Fig. 12.



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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 324,502, dated August 18, 1885.

Application filed April 6, 1885. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Magnet Systems for Electric-Arc Lamps, of which the following is a specification.

My invention relates to electro-magnet systems for effecting the feed or adjustment of the carbon in electric-arc lamps, and is designed to afford a simple and effective arrangement for such purpose.

In my invention I employ two magnets or coils, one in an arc or main circuit and the other in derived circuit around the arc. Heretofore such magnets have been employed to act upon the carbon or carbon-carrier differentially in either of the following ways: In one plan the coils have been placed upon the same core, and wound in opposite directions thereupon, so as to tend to neutralize one another's effects. In a second plan they have been arranged to act in opposite directions upon a common armature, or to act at the opposite sides of a fulcrum upon independent armatures carried by the same lever. In a third plan they have been arranged so as to tend to form poles of like name opposite one another, and thus to produce or effect a diminution of the attraction, one for the other, when a long arc occurs, one of said magnets being made movable with relation to the other, so as to permit a proper movement of the feed-regulating appliances.

My invention differs from all of the above arrangements in the fact that while I employ a main and a derived circuit-magnet, the main-circuit magnet acts upon an armature mechanically and magnetically independent of the derived-circuit magnet, the derived-circuit magnet being employed simply to shift or divert the magnetism of the main-circuit magnet, so as to decrease the lifting or pulling power of the latter upon the armature.

The derived-circuit magnet or coil of my invention may be made movable or not, and arranged to act upon the increase of its power to magnetically shunt the magnetism of the direct-circuit magnet, at the same time increasing the magnetic polarization of the latter, as induced by its own winding.

The arrangement of the devices is such that the result and effect of such increase and diversion of magnetism is to cause a weakening of the pull of the main-circuit magnet upon its armature, so as to permit the latter to fall away, and thus cause the proper movement of the feed-regulating mechanism for producing an approach of the carbons.

In the accompanying drawings I have illustrated my novel magnet system as applied to a simple form of electric lamp, but do not limit myself in any particular to any specified form or type of regulating mechanism, as my invention consists solely in the novel means of giving the armature or part operating upon such mechanism the proper movement in obedience to the variations of resistance between the carbons.

Referring to the drawings, Figures 1 and 2 are front and side elevations of a simple form of lamp embodying my invention. Fig. 3 is a longitudinal section on the line *x x* of Fig. 1. Fig. 4 is a diagram illustrating the action of the magnet-system. Figs. 5 and 6 illustrate a modification in which the derived-circuit magnet is fixed. Figs. 7 and 8 illustrate other modifications of the invention. Fig. 9 shows in perspective the cores of the magnet shown in Fig. 8 divested of their coils. Figs. 10 and 11 illustrate another modified form of the invention. Fig. 12 illustrates a modification in which the main-circuit magnet is made movable.

Referring to Figs. 1 and 2, *f f* F F indicate the side rods or standards of a frame connecting the bottom and top plates of the lamp.

R is the usual carbon rod or carrier, suitably guided in the frame, and E E′ the carbon rods or pencils.

The lifting and feeding mechanism acting upon the carbon-rod R is indicated at C, and consists in the present instance of the simple form of clutch, sometimes called a "ring-clutch," which is illustrated here as typical of any device for producing the desired movements of the carbon-rod. This clutch is operated by a movable armature, A, of iron, hung from a suitable rocker-frame that is hung at *p p* in the standards F F.

D indicates the main-circuit electro-magnet, supported in the frame in any suitable way, and arranged so that its poles P P′ may act

upon the armature A to lift the same and cause the separation of the carbons when the lamp starts into action. The electro-magnet D is wound, as usual, with coarse wire, and put into the electric circuit with the carbons E E′ in any usual or desired manner, so that the main current, or bulk of the current, supplied to the lamp will traverse it.

At K is indicated the derived-circuit magnet, whose coils are in a branch around the arc in the usual way, and whose core is provided with the rectangular pole-extensions N S, as shown. Although these poles, as will be hereinafter described, may be made fixed, they are preferably arranged so that they may move toward the poles of the main-circuit magnet D D. This may be readily accomplished by mounting the core of the magnet K in standards at *b b*, so that it may rock in said standards. A suitable retracting spring or weight, as indicated at Z, is applied, so that the poles N S shall be held away from the poles P P′ when the lamp is not in action. The spring Z may be made adjustable, as indicated. The current entering at X passes through the coils D and the arc at E E′ in its course to G, the exit-point. The magnet K is in the high-resistance branch around the carbons, as stated, but is connected and wound so that its north pole N will be presented to a south pole, P, of the magnet D, and its south pole S to a north pole, P′, of the same magnet. By this means when the magnet K is energized upon the formation of an arc at E E′ there will be a mutual attraction and magnetic coincidence between the core of magnet K and the cores of magnet D, poles of opposite names being presented to one another. Suitable stops are arranged to prevent undue movement of the parts. The poles of the magnets are so shaped or arranged with relation to one another and to the armature as to permit either the armature A or the poles N S to be attracted and moved by the poles P P′, either singly or together. The core of magnet K might be fixed, but when made movable, as shown in Figs. 1, 2, and 3, it is so adjusted by the spring Z that when the current is first put onto the lamp it cannot be drawn toward the poles P P′ until assisted by the polarization given to the core K by the current diverted by the arc after formation of the latter. In other words, the adjustment is made such that, unless energized to a certain point by its own coils, the magnet K will not be sufficiently attracted to the magnet D to move to any considerable extent. Under such circumstances the armature A is attracted toward the pole P P′, and, acting on the lift and feed mechanism, such as the clutch C, raises the rod R and forms an arc at E E′. At this moment current is conducted through the magnet K, owing to the increase of resistance in the circuit between the carbons. When sufficient current passes to K, it acts inductively by means of its poles and core upon the poles P P′ of the main-circuit magnet, intensifying the magnetism of the latter and, when movable, being drawn toward said poles. The result of this action is to divert the magnetism of the poles P P′ from the armature A to the core of the magnet K, since the opposed poles N S P P′ are poles of unlike name. The pull upon the armature A therefore begins to decrease and the latter begins to fall away from the magnet D, so that when the actions set forth have progressed to a sufficient extent the clutch or feed mechanism will be so lowered as to permit the feed of the carbon-rod to take place, after the well-known manner.

As will be seen in my invention, the function of the magnet K is different from its function in all previous cases, inasmuch as the core of the magnet K, by increased polarization, due to increase of current in its coils, forms a closed magnetic shunt for the magnetism of the main circuit magnet D, thus diverting such magnetism from action upon the armature A and permitting release of the latter. At the same time the polarization of each of the magnets D K is enhanced by its neighbor, as unlike poles are opposed.

An adjustment of arc can easily be obtained by varying the power of the magnet D, the force of the spring Z, the distance of the armature A from the poles P P′ or of the poles of the magnet K from poles P P′.

Fig. 4 shows in dotted lines the position which can be assumed by the armature A and the pole N of the magnet K in relation to pole P of the magnet D. When the pole N has moved to the position shown in dotted lines it is in such magnetic proximity to the pole P as to withdraw the magnetism from the latter, correspondingly depriving the armature A of such magnetic effects, and causing the latter to fall away by gravity or by the action of a spring. It is not necessary that the magnet K should be movable toward the magnet D, though it conduces to sensitiveness of action to arrange it in such way. In Fig. 5 it is shown as fixed in position, suitable adjusting devices being, however, applied to it—such, for instance, as a screw or nut, *t*—whereby it may be adjusted into magnetic proximity with poles of the main-circuit magnet. When no or very little current passes in the coils K, the magnetic lines of force are principally from the poles P to the armature A, as shown by the shading, and the movement of the armature is upward under the magnetic pull of the main-circuit magnet. When, however, the magnet K is strongly energized through the occurrence of a longer arc than normal, the magnetism of the main-circuit magnet is diverted, as shown by the shading in Fig. 6, from the pole P to the pole N, and the motion of the armature A is then downward, owing to the decreased pull exerted upon it from the poles of the main-circuit magnet.

In Figs. 5 and 6 the core or poles of the magnet K are separated from the poles of the magnet D. This is not, however, absolutely

necessary, and in Fig. 7 I have shown an arrangement in which the core or poles of the magnet K are in contact with the poles of the magnet D. In this instance, however, the core of the magnet K or its poles are made of tempered steel or of very hard steel, or of other substance having less magnetic capacity than soft iron. In the figure the pole T is supposed to be made of such substance. In this instance the actions will be substantially the same as in the case of the arrangements shown in Figs. 5 and 6. Under normal conditions, or at the start, the magnetism of the magnet D will be prevented from short-circuiting itself through the core of the magnet K, on account of the less magnetic capacity of the latter, and there will be an effectual amount of magnetism brought to bear upon the armature A to produce the necessary movement of the latter. When, however, the magnet K is sufficiently energized by the current diverted to it through the abnormal increase of arc, the polarization of said magnet will become so strong that a magnetic short-circuiting or diversion of magnetism from the magnet D will occur in sufficient amount to permit the armature A to fall back.

In the modification shown in Figs. 8 and 9 the magnetic short-circuiting or diversion of magnetism from the magnet D is effected by placing the short-circuiting core K in proper relation to a pair of false poles, Q Q, formed on the core of the magnet D at same distance from its true poles.

The two portions of the core of magnet D above and below the poles Q are designated by the letters *d d'*, respectively. The action is similar to that already described, the increase of magnetism in the core *k* of the derived-circuit magnet, due to increased diversion of current through the coils thereof, being effectual to divert the magnetic effects in the main-circuit magnet from the armature A by the short-circuiting, magnetically, of a portion of the core of magnet D—as, for instance, the portion *d d*.

In Figs. 10 and 11 the parts are shown somewhat differently arranged, but so as to embody the same principle of action. The armature A is arranged to move upward between the poles of the magnet D D, which latter are properly shaped for that purpose, and the magnet K is placed, as before, so as to short-circuit the magnetism of D.

In the arrangement shown in Fig. 12 the main-circuit magnet D is so mounted that its poles P may be moved toward the poles of the magnet K when the magnetic influence of the latter increases to the proper amount for overcoming the retractor Z, applied to said main-circuit magnet. By this arrangement the same effects are practically produced as by mounting the magnet K to be movable, after the manner shown in Figs. 1, 2, &c.; but to the increased short-circuiting effects due to such arrangement is superadded the effect produced by the moving of the poles P P' away from the armature A. In this case, therefore, the decreased attraction upon the armature A is due to, first, the increased magnetism of K; second, to the approach of the poles of magnet D to those of K, (these two actions conducing to a diversion of magnetism from the armature A;) and, third, to the separation of the poles of magnet D from the armature A, so as to, by the increased distance between them, decrease the magnetic pull.

I make no claim herein to the combination, in an electric lamp, of a main-circuit magnet and armature therefor, and a second magnet operating on the latter, on an increase in the length of arc, to move the poles of the main-circuit magnet away from its armature, as this broad invention, as well as the specific modification of the invention hereinafter claimed, which specific modification is shown in Fig. 12 of the drawings, will form the subject of a separate application for patent.

What I claim as my invention is—

1. The magnet system substantially such as described, and consisting, essentially, of a main-circuit electro-magnet operating upon regulating appliances of the lamp, and a derived-circuit magnet applied in the manner described, so as to constitute a magnetic shunt to the main circuit magnet of varying power, corresponding to the variations in the amount of current flowing in the derived-circuit coil.

2. In an electric-arc lamp, the combination, with the regulating mechanism, of a main-circuit magnet acting upon the mechanism for effecting the feed and adjustment of the carbons, and a derived-circuit magnet magnetically shunting the main-circuit magnet, the poles of the two magnets being movable to and from each other under the varying strength of current in the derived-circuit magnet.

3. The combination, in an electric-arc lamp, of an electro-magnet and armature for regulating the feed and adjustment of the carbons, and a magnetic shunting bar or magnet applied to the former, the unlike poles of the two magnets presented to one another.

4. The combination, in an electric-arc lamp, of a main-circuit magnet, an armature for regulating the feed, and a magnetic shunting bar or magnet applied to the feed-regulating magnet, and having wound upon it a coil in the derived circuit around the arc, unlike poles of the two magnets being presented to one another.

5. The combination, in an electric lamp, of a main-circuit magnet, regulating appliances governed thereby, and a derived-circuit magnet, said magnets having unlike poles presented to one another, and one or the other movable as respects its poles, whereby under the mutual attraction of the two magnets the poles may approach and the short-circuiting of the magnetism of the main-circuit magnet be enhanced.

6. The combination, in an electric lamp, of

a main-circuit magnet and an adjustable derived-circuit magnet having its poles arranged to attract the poles of the main-circuit magnet, thereby acting as a magnetic shunt to the latter.

7. In an electric lamp, the combination, with a main-circuit magnet, of a bar of magnetic material for directing magnetism from the main-circuit magnet, said bar being magnetized in varying amount, corresponding to the variations in the length of the electric arc.

8. The combination, with a main-circuit magnet, of a short-circuiting armature having magnetizing-coils in a derived circuit around the arc, and connected, as described, so as to divert the magnetism of the main-circuit magnet, as and for the purpose described.

9. In a regulating-magnet system, the combination, with a main-circuit magnet, of a magnetic shunting bar or magnet, the poles of the main-circuit magnet and shunting-bar being movable to and from each other in response to the varying strength of current in a derived circuit.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 31st day of March, A. D. 1885.

ELIHU THOMSON.

Witnesses:
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A. L. ROHRER.